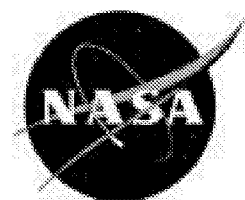


NASA/SP—2000—7037/SUPPL414
April 2000

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES



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Typical Report Citation and Abstract

- ❶ 19970001126 NASA Langley Research Center, Hampton, VA USA
- ❷ Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes
- ❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA; Mar. 1996; 130p; In English
Contract(s)/Grant(s): RTOP 505-68-70-04
- ❹ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
- ❺ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10° to 50°, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65° swept forebody serrations tended to roll together, while vortices from 40° swept serrations were more effective in generating additional lift caused by their more independent nature.
- ❻ Author
- ❼ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

Key

- 1. Document ID Number; Corporate Source
- 2. Title
- 3. Author(s) and Affiliation(s)
- 4. Publication Date
- 5. Contract/Grant Number(s)
- 6. Report Number(s); Availability and Price Codes
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- 8. Abstract Author
- 9. Subject Terms

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 414)

APRIL 2000

01

AERONAUTICS (GENERAL)

Includes general research topics related to manned and unmanned aircraft and the problems of flight within the Earth's atmosphere. Also includes manufacturing, maintenance, and repair of aircraft.

20000027414 Society of Experimental Test Pilots, Lancaster, CA USA

1999 Report to the Aerospace Profession: Forty Third Symposium Proceedings

September 1999; ISSN 0742-3705; 226p; In English; 43rd, 23-25 Sep. 1999, Beverly Hills, CA, USA; See also 20000027415 through 20000027429; Copyright; Avail: Issuing Activity

The objectives of the Society of Experimental Test Pilots (SETP) is to Promote air safety by presenting pilot's opinion; Strengthen the influence of the test pilot on aeronautical progress; Continuously evaluate the adequacy of flight equipment; Exchange information for the development of improved testing techniques; Exchange ideas, experiences, and information concerning techniques of escape and survival; Discuss newly experienced phenomena in the realm of flight; Further professional advancement through lectures and displays; Stimulate interest in aviation careers through scholarships and other projects among the youth of the world; and Broaden professional and fraternal relationships.

Derived from text

Conferences; Lectures; Papers; Reports

20000027499 NASA Ames Research Center, Moffett Field, CA USA

The History of the XV-15 Tilt Rotor Research Aircraft from Concept to Flight

Maisel, Martin D., NASA Ames Research Center, USA; Giulianetti, Demo J., NASA Ames Research Center, USA; Dugan, Daniel C., NASA Ames Research Center, USA; [2000]; 220p; In English

Report No.(s): NASA/SP-2000-4517; NAS 1.21:4517; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

This monograph is a testament to the efforts of many people overcoming multiple technical challenges encountered while developing the XV-15 tilt rotor research aircraft. The Ames involvement with the tilt rotor aircraft began in 1957 with investigations of the performance and dynamic behavior of the Bell XV-3 tilt rotor aircraft. At that time, Ames Research Center was known as the Ames Aeronautical Laboratory of the National Advisory Committee for Aeronautics (NACA). As we approach the new millennium, and after more than 40 years of effort and the successful completion of our initial goals, it is appropriate to reflect on the technical accomplishments and consider the future applications of this unique aircraft class, the tilt rotor. The talented engineers, technicians, managers, and leaders at Ames have worked hard with their counterparts in the U.S. rotorcraft industry to overcome technology barriers and to make the military and civil tilt rotor aircraft safer, environmentally acceptable, and more efficient. The tilt rotor aircraft combines the advantages of vertical takeoff and landing capabilities, inherent to the helicopter, with the forward speed and range of a fixed wing turboprop airplane. Our studies have shown that this new vehicle type can provide the aviation transportation industry with the flexibility for highspeed, long-range flight, coupled with runway-independent operations, thus having a significant potential to relieve airport congestion. We see the tilt rotor aircraft as an element of the solution to this growing air transport problem.

Derived from text

XV-15 Aircraft; Tilt Rotor Research Aircraft Program; Civil Aviation; Aircraft Design; Wind Tunnel Tests

20000027501 NASA Langley Research Center, Hampton, VA USA

Aeronautical Engineering: A Continuing Bibliography With Indexes, Supplement 406

August 1999; 60p; In English

Report No.(s): NASA/SP-1999-7037/SUPPL406; NAS 1.21:7037/SUPPL406; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This supplemental issue of Aeronautical Engineering, A Continuing Bibliography with Indexes (NASA/SP-1999-7037) lists reports, articles, and other documents recently announced in the NASA STI Database. The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles. Each entry in the publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract. Two indexes-subject and author are included after the abstract section.

CASI

Aerodynamics; Aeronautical Engineering; Bibliographies; Indexes (Documentation)

20000031244 Technische Univ., Hermann-Fottinger Inst. fuer Stroemungsmechanik, Berlin, Germany

10th European Drag Reduction Working Meeting: Book of Abstracts

Mar. 24, 1997; 49p; In English; 10th; Drag Reduction, 19-21 Mar. 1997, Berlin, Germany; See also 20000031245 through 20000031269

Contract(s)/Grant(s): F61708-97-W-0088

Report No.(s): AD-A371292; EOARD-CSP-97-1031; No Copyright; Avail: Defense Technical Information Center (DTIC); Abstracts Only

The final proceedings for 10th European Drag Reduction Working Meeting 19 March 1997-27 March 1997 Flow Characteristics over and around Riblets, Effects of Polymer Additives to Drag Reduction, Drag Reduction by Surfactants, Biological Aspects, Control of Transition, Turbulence and Separation, Longitudinal Vortices and Two-Phase Flows.

Author

Drag Reduction; Abstracts; Flow Characteristics; Riblets; Conferences

20000031533 Boeing Co., Seattle, WA USA

Configuration Aerodynamics ITD Team

Wilson, Douglas L., Boeing Co., USA; 1998 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 1-29; In English; See also 20000031532; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

This paper presents viewgraphs to select the best analysis or design optimization methods for high speed aviation. The program goals are to demonstrate significant lift/drag maximum gains. The topics include: 1) Challenges (validation, viscous effects, multi-point conditions, and power effects); 2) Approaches (analytic methods and applications, design development, and test programs); and 3) Program (methods down select, viscous drag prediction, cruise point optimization, multi-point optimization and s&c cfd Predictions).

CASI

Aerodynamic Configurations; Computational Fluid Dynamics; Design Analysis; Supersonic Transports; Airframes

20000032341 Nebraska Univ., Omaha, NE USA

Facilitating Student Involvement in NASA Research: The NASA Space Grant Aeronautics Example

Bowen, Brent D., Nebraska Univ., USA; NASA University Research Centers Technical Advances in Aeronautics, Space Sciences and Technology, Earth Systems Sciences, Global Hydrology, and Education; Feb. 22, 1998; Volumes 2 and 3, pp. 960-970; In English; See also 20000032189; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche; C01, CD-ROM

Many consider NASA programs to be exclusively space-oriented. However, NASA's roots originated in the aeronautical sciences. Recent developments within NASA elevated the declining role of aeronautics back to a position of priority. On a parallel pattern, aeronautics was a priority in the legislation which authorized the National Space Grant College and Fellowship Program. This paper outlines the development of the aeronautics aspect of the National Space Grant College and Fellowship Program, and the resulting student opportunities in research. Results from two aeronautics surveys provide a baseline and direction for further development. A key result of this work is the increase in student research opportunities which now exist in more states and at the national level.

Author

NASA Programs; Research; Research and Development; Project Management; Priorities

20000032683 Research and Technology Organization, Human Factors and Medicine, Neuilly-sur-Seine, France
Human Consequences of Agile Aircraft Cycle de conferences sur les facteurs humains lies au pilotage des avions de combat tres manoeuvrants

March 2000; 92p; In English, 20-21 Mar. 2000, Neubiberg, Preston, Ohio, Germany, UK, USA; See also 20000032684 through 20000032689

Report No.(s): RTO-EN-12; AC/323(HFM)TP/32; ISBN 92-837-1036-3; Copyright Waived; Avail: CASI; A05, Hardcopy; A01, Microfiche; C01, CD-ROM

This Lecture Series evaluates the human factors implications for pilots of "superagile flight", specifically with regard to agile airframes, agile weapons, and rapidly configurable systems. During interviews, experienced pilots have confirmed the operational need for military aircraft agility. Although pilots have noted that their experiences to date have not caused them any major concerns regarding the potential for physiological problems, significant gaps remain in our understanding of the effects of multi-axis accelerations. Human consequences are also anticipated in the area of situational awareness. Presentation of aircraft attitude and energy state in a helmet mounted display will be a design challenge. The minimal constraints on aircraft incidence angles and the expanded weapon launch envelopes anticipated with the forthcoming and next generations of air systems requires the provision of novel displays to enable pilots to effectively operate such air systems. Decision aids, intelligent interfaces and automated subsystems are required to enable pilots to maintain situational awareness whilst coping with dramatic increases in the tempo of the tactical situation and the 'data deluge'. Moreover, many of the current pilot protection systems will be inadequate for everyday use in such an unconstrained flight envelope and during ejection. Additional challenges in selection, simulation, and training are also anticipated.

Derived from text

Human Factors Engineering; Decision Support Systems; Aircraft Pilots; Pilot Training; Lectures; Human-Computer Interface

20000032685 Office National d'Etudes et de Recherches Aerospatiales, System Control and Flight Dynamics Dept., Salon Air, France

Agility: History, Definitions and Basic Concepts

LeBlaye, Patrick, Office National d'Etudes et de Recherches Aerospatiales, France; Human Consequences of Agile Aircraft; March 2000, pp. 2 - 1 - 2 - 13; In English; See also 20000032683; Copyright Waived; Avail: CASI; A03, Hardcopy

The purpose of this presentation is to provide some engineering basis of the concept of agility. We'll see that the definition of agility has evolved across recent aviation history, from the well known area of airframe agility to a global concept of operational agility. We'll give some consensus definition, some of which have been proposed by the working group 19 of the Flight Mechanics Panel of AGARD. We'll briefly examine the concepts of agility relative to each component of the system (airframe, systems, weapons) and give some orders of magnitude of present and future weapon systems performances, which may have particular consequences on the human in flight. We'll then examine the concept of operational agility and conclude with some perspectives for potential areas of preoccupation relative to the role of human pilots in the future combat scenarios and information environment.

Author

Aircraft Performance; Aircraft Maneuvers; Flight Characteristics; Flight Mechanics; Flight Control

20000032859 Research and Technology Organization, Applied Vehicle Technology, Neuilly-sur-Seine, France
Application of Damage Tolerance Principles for Improved Airworthiness of Rotorcraft l'Application des principes de la tolerance a l'endommagement pour une meilleure aptitude au vol des aeronefs and voilure tournante

February 2000; 202p; In English, 21-22 Apr. 1999, Corfu, Greece; See also 20000032860 through 20000032874

Report No.(s): RTO-MP-24; AC/323(AVT)TP/12; ISBN 92-837-1024-X; Copyright Waived; Avail: CASI; A10, Hardcopy; A03, Microfiche; C01, CD-ROM

The Specialists' Meeting dealt with Aging Systems and more specifically Application of Damage Tolerance Principles for Improved Airworthiness of Rotorcraft. These proceedings include a Keynote Address and fifteen papers having the objective of discussing and presenting the applicability of the new design approach to major rotorcraft components such as the dynamic system, primary load carrying structures, and flight control systems. Both metal and composite structures including special material related topics such as crack growth models and delamination modelling were examined. There were three sessions covering the following topics: Material Data and Crack Growth Models for DT-Approaches fo Helicopter Structures; Design

Application of DT-Principle; and Operator Experience and Certification Issues. A Technical Evaluation Report of this meeting is also included.

Author

Conferences; Rotary Wing Aircraft; Aircraft Reliability; Damage; Tolerances (Mechanics); Fatigue (Materials); Aircraft Structures; Systems Health Monitoring; Structural Reliability; Structural Failure

02 AERODYNAMICS

Includes aerodynamics of flight vehicles, test bodies, airframe components and combinations, wings, and control surfaces. Also includes aerodynamics of rotors, stators, fans and other elements of turbomachinery.

20000027440 NASA Langley Research Center, Hampton, VA USA

High-Speed Research: 1994 Sonic Boom Workshop. Configuration, Design, Analysis and Testing

McCurdy, David A., Editor, NASA Langley Research Center, USA; December 1999; 306p; In English; 3rd, 1-3 Jun. 1994, Hampton, VA, USA; Sponsored by NASA, USA; See also 20000027441 through 20000027455

Contract(s)/Grant(s): RTOP 537-03-21-03

Report No.(s): NASA/CP-1999-209699; L-17435; NAS 1.55:209699; No Copyright; Avail: CASI; A14, Hardcopy; A03, Microfiche

The third High-Speed Research Sonic Boom Workshop was held at NASA Langley Research Center on June 1-3, 1994. The purpose of this workshop was to provide a forum for Government, industry, and university participants to present and discuss progress in their research. The workshop was organized into sessions dealing with atmospheric propagation; acceptability studies; and configuration design, and testing. Attendance at the workshop was by invitation only. The workshop proceedings include papers on design, analysis, and testing of low-boom high-speed civil transport configurations and experimental techniques for measuring sonic booms. Significant progress is noted in these areas in the time since the previous workshop a year earlier. The papers include preliminary results of sonic boom wind tunnel tests conducted during 1993 and 1994 on several low-boom designs. Results of a mission performance analysis of all low-boom designs are also included. Two experimental methods for measuring near-field signatures of airplanes in flight are reported.

Author

Sonic Booms; Conferences; Supersonic Flight; Aircraft Configurations

20000027444 NASA Langley Research Center, Hampton, VA USA

Wind-Tunnel Overpressure Signatures From a Low-Boom HSCT Concept With Aft-Fuselage-Mounted Engines

Mack, Robert J., NASA Langley Research Center, USA; High-Speed Research: 1994 Sonic Boom Workshop. Configuration, Design, Analysis and Testing; December 1999, pp. 59-71; In English; See also 20000027440; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

A 1:300 scale wind-tunnel model of a conceptual High-Speed Civil Transport (HSCT) designed to generate a shaped, low-boom pressure signature on the ground was tested to obtain sonic-boom pressure signatures in the Langley Research Center Unitary Plan Wind Tunnel at a Mach number of 1.8 and a separation distance of about two body lengths or four wing-spans from the model. Two sets of engine nacelles representing two levels of engine technology were used on the model to determine the effects of increased nacelle volume. Pressure signatures were measured for (model lift)/(design lift) ratios of 0.5, 0.63, 0.75, and 1.0 so that the effect of lift on the pressure signature could be determined. The results of these tests were analyzed and used to discuss the agreement between experimental data and design expectations.

Author

Sonic Booms; Supersonic Transports; Separated Flow; Scale Models; Nacelles; Pressure Distribution; Boundary Layer Separation; Aircraft Configurations

20000027647 NASA Langley Research Center, Hampton, VA USA

1995 NASA High-Speed Research Program Sonic Boom Workshop, Volume 2, Configuration Design, Analysis, and Testing

Baize, Daniel G., Editor, NASA Langley Research Center, USA; 1995 NASA High-Speed Research Program Sonic Boom Workshop; December 1999; 188p; In English, 12-13 Sep. 1995, Hampton, VA, USA; See also 20000027648 through 20000027655

Contract(s)/Grant(s): RTOP 537-07-21-21

Report No.(s): NASA/CP-1999-209520/VOL2; NAS 1.55:209520/VOL2; L-17573/VOL2; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

The High-Speed Research Program and NASA Langley Research Center sponsored the NASA High-Speed Research Program Sonic Boom Workshop on September 12-13, 1995. The workshop was designed to bring together NASAs scientists and engineers and their counterparts in industry, other Government agencies, and academia working together in the sonic boom element of NASAs High-Speed Research Program. Specific objectives of this workshop were to: (1) report the progress and status of research in sonic boom propagation, acceptability, and design; (2) promote and disseminate this technology within the appropriate technical communities; (3) help promote synergy among the scientists working in the Program; and (4) identify technology pacing, the development C, of viable reduced-boom High-Speed Civil Transport concepts. The Workshop was organized in four sessions: Sessions 1 Sonic Boom Propagation (Theoretical); Session 2 Sonic Boom Propagation (Experimental); Session 3 Acceptability Studies-Human and Animal; and Session 4 - Configuration Design, Analysis, and Testing.

Author

High Speed; Conferences; Sonic Booms; Evaluation

20000027648 NASA Langley Research Center, Hampton, VA USA

A Whitham-Theory Sonic-Boom Analysis of the TU-144 Aircraft at a Mach Number of 2.2

Mack, Robert J., NASA Langley Research Center, USA; 1995 NASA High-Speed Research Program Sonic Boom Workshop; December 1999; Volume 2, pp. 1-16; In English; See also 20000027647; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

Officially, the TU-144 was the first supersonic-cruise, passenger-carrying aircraft to enter commercial service. Design, construction, and testing were carried out by the Soviet Union, flight certification was by the Soviet Union, and the only regular passenger flights were scheduled and flown across the territory of the Soviet Union. Although it was not introduced to international passenger service, there were many significant engineering accomplishments achieved in the design, production, and flight of this aircraft. Development of the aircraft began with a prototype stage. Systematic testing and redesign led to a production aircraft in discrete stages that measurably improved the performance of the aircraft from the starting concept to final aircraft certification. It flew in competition with the English-French Concorde for a short time, but was withdrawn from national commercial service due to a lack of interest by airlines outside the Soviet Union. NASA became interested in the TU- 144 aircraft when it was offered for use as a flying "testbed" in the study of operating characteristics of a supersonic-cruise commercial airplane. Since it had been in supersonic-cruise service, the TU- 144 had operational characteristics similar to those anticipated in the conceptual aircraft designs being studied by the USA aircraft companies. In addition to the other operational tests being conducted on the TU-144 aircraft, it was proposed that two sets of sonic-boom pressure signature measurements be made. The first set would be made on the ground, using techniques and devices similar to those in reference I and many other subsequent studies. A second set would be made in the air with an instrumented aircraft flying close under the TU-144 in supersonic flight. Such in-flight measurements would require pressure gages that were capable of accurately recording the flow-field overpressures generated by the TU- 144 at relatively close distances under the vehicle. Therefore, an analysis of the TU-144 was made to obtain predictions of pressure signature shape and shock strengths at cruise conditions so that the range and characteristics of the required pressure gages could be determined well in advance of the tests. Cancellation of the sonic-boom signature measurement part of the tests removed the need for these pressure gages. Since CFD methods would be used to analyze the aerodynamic performance of the TU-144 and make similar pressure signature predictions, the relatively quick and simple Whitham-theory pressure signature predictions presented in this paper could be used for comparisons. Pressure signature predictions of sonic-boom disturbances from the TU-144 aircraft were obtained from geometry derived from a three-view description of the production aircraft. The geometry was used to calculate aerodynamic performance characteristics at supersonic-cruise conditions. These characteristics and Whitham/Walkden sonic-boom theory were employed to obtain F-functions and flow-field pressure signature predictions at a Mach number of 2.2, at a cruise altitude of 61000 feet, and at a cruise weight of 350000 pounds.

Derived from text

Aerodynamic Characteristics; Commercial Aircraft; Computational Fluid Dynamics; Pressure Measurement; Supersonic Flight; Supersonic Speed; TU-144 Aircraft

20000027649 Lockheed Engineering and Sciences Co., Hampton, VA USA

Langley's Computational Efforts in Sonic-Boom Softening of the Boeing HSCT

Fouladi, Kamran, Lockheed Engineering and Sciences Co., USA; 1995 NASA High-Speed Research Program Sonic Boom Workshop; December 1999; Volume 2, pp. 47-72; In English; See also 20000027647

Contract(s)/Grant(s): NAS1-19000; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

NASA Langley's computational efforts in the sonic-boom softening of the Boeing high-speed civil transport are discussed in this paper. In these efforts, an optimization process using a higher order Euler method for analysis was employed to reduce the sonic boom of a baseline configuration through fuselage camber and wing dihedral modifications. Fuselage modifications did not provide any improvements, but the dihedral modifications were shown to be an important tool for the softening process. The study also included aerodynamic and sonic-boom analyses of the baseline and some of the proposed "softened" configurations. Comparisons of two Euler methodologies and two propagation programs for sonic-boom predictions are also discussed in the present paper.

Author

Sonic Booms; Computation; Supersonic Transports; Civil Aviation

20000027650 NASA Langley Research Center, Hampton, VA USA

Sonic Boom Minimization Efforts on Boeing HSCT Baseline

Cheung, Samson H., McDonnell-Douglas Aerospace, USA; Fouladi, Kamran, NASA Langley Research Center, USA; Haglund, George, Boeing Commercial Airplane Co., USA; Tu, Eugene, NASA Ames Research Center, USA; 1995 NASA High-Speed Research Program Sonic Boom Workshop; December 1999; Volume 2, pp. 73-94; In English; See also 20000027647; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

A team was formed to tackle the sonic boom softening issues of the current Boeing HSCT design. The team consisted of personnel from NASA Ames, NASA Langley, and Boeing company. The work described in this paper was done when the first author was at NASA Ames Research Center. This paper presents the sonic boom softening work on two Boeing High Speed Civil Transport (HSCT) baseline configurations, Reference-H and Boeing-1122. This presentation can be divided into two parts: parametric studies and sonic boom minimization by CFD optimization routines.

Author

Sonic Booms; Design Analysis; Softening; Parameterization; Supersonic Transports

20000027651 Boeing Commercial Airplane Co., Seattle, WA USA

Potential for Sonic Boom Reduction of the Boeing HSCT

Haglund, George T., Boeing Commercial Airplane Co., USA; 1995 NASA High-Speed Research Program Sonic Boom Workshop; December 1999; Volume 2, pp. 96-120; In English; See also 20000027647

Contract(s)/Grant(s): NAS1-20220; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

The HSR sonic boom technology program includes a goal of reducing the objectionable aspects of sonic boom. Earlier HSCT sonic boom studies considered achieving significant sonic boom reduction by the use of arrow-wing planforms and detailed shaping of the airplane to produce shaped waveforms (non N-waves) at the ground. While these design efforts were largely successful, the added risk and cost of the airplanes were judged to be unacceptable. The objective of the current work is to explore smaller configuration refinements that could lead to reduced sonic boom impact, within design and operational constraints. A somewhat modest target of 10% reduction in sonic boom maximum overpressure was selected to minimize the effect on the configuration performance. This work was a joint NASA/Industry effort, utilizing the respective strengths of team members at Boeing, NASA Langley, and NASA Ames. The approach used was to first explore a wide range of modifications and airplane characteristics for their effects on sonic boom and drag, using classical Modified Linear Theory (MLT) methods. CFD methods were then used to verify promising modifications and to analyze modifications for which the MLT methods were not appropriate. The team produced a list of configuration changes with their effects on sonic boom and, in some cases, an estimate of the drag penalty. The most promising modifications were applied to produce a boom-softened derivative of the baseline Boeing High Speed Civil Transport (HSCT) configuration. This boom-softened configuration was analyzed in detail for the reduce sonic boom impact and also for the effect of the configuration modifications on drag, weight, and overall performance relative to the baseline.

Author

Sonic Booms; Supersonic Transports; Waveforms; Sound Transmission

20000027652 NASA Langley Research Center, Hampton, VA USA

Boom Softening and Nacelle Integration on an Arrow-Wing High-Speed Civil Transport Concept

Mack, Robert J., NASA Langley Research Center, USA; 1995 NASA High-Speed Research Program Sonic Boom Workshop; December 1999; Volume 2, pp. 121-136; In English; See also 20000027647; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

During the last cycle of concept design and wind-tunnel testing, the goal of the low-boom- shaped HSCT concepts (the B-935, the LB-16, and the LB- 18) was to meet mission requirements and generate shaped, ground-level pressure signatures with nose shock strengths of 1.0 psf or less. The wind-tunnel tests of these concepts produced results that were partially successful and

encouraging although not fully up to expectations. In spite of this, however, these conceptual designs were overly optimistic and not acceptable because: the wing planforms had excessive area; the wing structural aspect ratio was too high; one concept had aft-fuselage rather than under-the-wing engines; and the gross takeoff weights were unrealistically low because of engines that were early, high-tech versions of later, revised, more-realistic engines. The need for reducing the ground-level overpressure shock strengths still existed; a need to be met within more restrictive guidelines of mission performance and gross takeoff weight limitations. Therefore, it was decided that the next conceptual design cycle would focus on decreased nose shock strengths, "boom softening," in the signatures of the Boeing and the McDonnell Douglas baseline concepts rather than low-boom concepts with shaped-signature designs. Overly-optimistic results were not the only problem with these low-sonic-boom concepts. Papers given at the 1994 Sonic-Boom Workshop had demonstrated that the problem of successful nacelle integration on HSCT concepts had only been partially solved. Wind-tunnel pressure signature data, from the HSCT-11B (a.k.a. the LB-18) wind-tunnel model, showed that the Langley HSCT design and analysis method had been successful in reducing the nacelle-volume disturbances in the flow field. This was due to the engine nacelles mounted behind the wing trailing-edge on the aft fuselage so that no nacelle-wing interference-lift flow-field disturbances were generated. While acceptable from a sonic-boom research point of view, this concept was unacceptable from several practical and structural considerations. Preliminary wind-tunnel pressure signature data from the LB-16 wind-tunnel model, which had the engine nacelles mounted under the wings (the usual location), indicated that the application of the Langley nacelle-integration method had been only partially successful in the reduction of the nacelle-volume with nacelle-wing interference-lift pressure disturbances. So, "boom softening" had to also address the task of successful integration of the engine nacelles, with the engines in the required under-the-wing location. Unless this problem was solved, low-sonic-boom and low-drag modifications to the wing planform, the airfoil shape, and the fuselage longitudinal area distribution could be nullified if the nacelle disturbances added increments to the nose-shock strengths that were removed through component tailoring. In this paper, an arrow-wing boom-softened HSC7 concept which incorporated modifications to a baseline McDonnell Douglas concept is discussed. The analysis of the concept's characteristics will include estimates of weight, center of gravity, takeoff field length, mission range, and predictions of its ground-level sonic-boom pressure signature. Additional modifications which enhanced the softened-boom performance of this concept are also described as well as estimates of the performance penalties induced by these modifications.

Derived from text

Sonic Booms; Nacelles; Arrow Wings; High Speed; Supersonic Transports; Civil Aviation; Softening; Wind Tunnel Tests

20000027653 Northrop Grumman Corp., Advanced Technology and Development Center, Bethpage, NY USA

Sonic Boom Prediction and Minimization of the Douglas Reference OPT5 Configuration

Siclari, Michael J., Northrop Grumman Corp., USA; 1995 NASA High-Speed Research Program Sonic Boom Workshop; December 1999; Volume 2, pp. 138-160; In English; See also 20000027647; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

Conventional CFD methods and grids do not yield adequate resolution of the complex shock flow pattern generated by a real aircraft geometry. As a result, a unique grid topology and supersonic flow solver was developed at Northrop Grumman based on the characteristic behavior of supersonic wave patterns emanating from the aircraft. Using this approach, it was possible to compute flow fields with adequate resolution several body lengths below the aircraft. In this region, three-dimensional effects are diminished and conventional two-dimensional modified linear theory (MLT) can be applied to estimate ground pressure signatures or sonic booms. To accommodate real aircraft geometries and alleviate the burdensome grid generation task, an implicit marching multi-block, multi-grid finite-volume Euler code was developed as the basis for the sonic boom prediction methodology. The Thomas two-dimensional extrapolation method is built into the Euler code so that ground signatures can be obtained quickly and efficiently with minimum computational effort suitable to the aircraft design environment. The loudness levels of these signatures can then be determined using a NASA generated noise code. Since the Euler code is a three-dimensional flow field solver, the complete circumferential region below the aircraft is computed. The extrapolation of all this field data from a cylinder of constant radius leads to the definition of the entire boom corridor occurring directly below and off to the side of the aircraft's flight path yielding an estimate for the entire noise "annoyance" corridor in miles as well as its magnitude. An automated multidisciplinary sonic boom design optimization software system was developed during the latter part of HSR Phase 1. Using this system, it was found that sonic boom signatures could be reduced through optimization of a variety of geometric aircraft parameters. This system uses a gradient based nonlinear optimizer as the driver in conjunction with a computationally efficient Euler CFD solver (NIIM3DSB) for computing the three-dimensional near-field characteristics of the aircraft. The intent of the design system is to identify and optimize geometric design variables that have a beneficial impact on the ground sonic boom. The system uses a simple wave drag data format to specify the aircraft geometry. The geometry is internally enhanced and analytic methods are used to generate marching grids suitable for the multi-block Euler solver. The Thomas extrapolation method is integrated into this system, and hence, the aircraft's centerline ground sonic boom signature is also automatically computed for

a specified cruise altitude and yields the parameters necessary to evaluate the design function. The entire design system has been automated since the gradient based optimization software requires many flow analyses in order to obtain the required sensitivity derivatives for each design variable in order to converge on an optimal solution. Hence, once the problem is defined which includes defining the objective function and geometric and aerodynamic constraints, the system will automatically regenerate the perturbed geometry, the necessary grids, the Euler solution, and finally the ground sonic boom signature at the request of the optimizer.

Derived from text

Sonic Booms; Prediction Analysis Techniques; Aircraft Design; Computational Grids; Design Analysis; Multidisciplinary Design Optimization

20000027654 McDonnell-Douglas Aerospace, Long Beach, CA USA

Potential for Sonic Boom Reduction of the 2.4-II5085 Arrow Wing HSCT

Morgenstern, John M., McDonnell-Douglas Aerospace, USA; 1995 NASA High-Speed Research Program Sonic Boom Workshop; December 1999; Volume 2, pp. 162-174; In English; See also 20000027647; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

Preliminary human acceptability studies of sonic booms indicate that supersonic flight is unlikely to be acceptable even at noise levels significantly below 1994 low boom designs (reference 1, p. 288). Further, these low boom designs represent considerable changes to baseline configurations, and changes translate into additional effort and uncertain structural weight penalties that may provide no annoyance benefit, increasing the risk of including low boom technology. Since over land sonic boom designs were so risky (and yet the acceptability studies highlight how annoying sonic booms are), boom softening studies were undertaken to reduce the boom of baseline configurations using minor modifications that would not significantly change the designs. The goal of this work is to reduce boom levels over water. Even though Concorde over water boom has not been found to have any adverse environmental impact, boom levels for baseline HSCT designs are 50% higher in overpressure than the Concorde (due to a doubling in configuration weight with only a 50% increase in length),

Author

Sonic Booms; Supersonic Transports; Softening; Environmental Surveys; Civil Aviation; Acceptability

20000027655 Arizona State Univ., Dept. of Mechanical and Aerospace Engineering, Tempe, AZ USA

Development of a Multiobjective Optimization Procedure for Sonic Boom Minimization

Narayan, J. R., Arizona State Univ., USA; Chattopadhyay, A., Arizona State Univ., USA; Pagaldi, N., Arizona State Univ., USA; 1995 NASA High-Speed Research Program Sonic Boom Workshop; December 1999; Volume 2, pp. 18-46; In English; See also 20000027647

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A design optimization procedure for improved sonic boom and aerodynamic performance of high speed aircraft is presented. The multiobjective optimization procedure simultaneously minimizes the sonic boom at a given distance from the aircraft and the drag-to-lift ratio ($C_{\text{sub D}}/C_{\text{sub L}}$) of the aircraft. Upper and lower bounds are also imposed on the lift coefficient. The Kreisselmeier - Steinhauser function is used for the multiobjective optimization formulation. A discrete semi-analytical aerodynamic sensitivity analysis procedure coupled with an analytical grid sensitivity analysis technique is used for evaluating design sensitivities. The use of the semi-analytical sensitivity analysis techniques results in significant computational savings. The flow equations are solved using a three-dimensional parabolized Navier-Stokes solver. Sonic boom analysis is performed using an extrapolation procedure. A nonlinear programming technique and an approximate analysis procedure are used for the optimization. The optimization procedure developed is applied to the design of two high speed configurations, namely, a doubly swept wing-body configuration and a delta wing-body configuration. For the two sweep case only, minimization of the first peak in the pressure signature is performed first by optimizing only the nose radius and length of the aircraft. Minimization of the second peak in the pressure signature is performed next by optimizing only the wing geometric parameters. Significant improvements are obtained in the sonic boom characteristics and the aerodynamic performance of the wing-body configurations.

Author

Procedures; Optimization; Aerodynamic Characteristics; Sonic Booms; Design Analysis

20000027689 Academy of Sciences (USSR), Inst. of Hydrodynamics, Novosibirsk, USSR

The Preliminary Studies of Survivability of Nozzle Throat Materials in Ultrahigh Pressure of Nitrogen and Air *Final Report*

Toptchiian, Marlen, Academy of Sciences (USSR), USSR; Nov. 1999; 19p; In English

Contract(s)/Grant(s): F61708-97-W-0138

Report No.(s): AD-A373115; EOARD-SPC-97-4044; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

One of the most complicated problems of the up-to-date experimental aerodynamics in simulation a hypersonic flight is the survival of a nozzle throat of a wind tunnel. An attempt to produce a flow ahead of a model, provided that the flow parameters are closely approximating natural those by general similarity criteria, leads to a rise of gas parameters in a settling chamber. In the modern operating facilities the pressure is up to 1 GPa¹, temperatures are from 2000 to 10000 K² for an operating time from a millisecond to several tenth fractions of a second.

DTIC

Hypersonic Flight; Composite Materials; Wind Tunnels; Nozzle Geometry; Flight Simulation

20000029549 NASA Langley Research Center, Hampton, VA USA

Theory and Experiment of Multielement Airfoils: A Comparison

Czerwiec, Ryan, North Carolina State Univ., USA; Edwards, J. R., North Carolina State Univ., USA; Rumsey, C. L., NASA Langley Research Center, USA; Hassan, H. A., North Carolina State Univ., USA; [2000]; 11p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

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Report No.(s): AIAA Paper 2000-0985; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

A detailed comparison of computed and measured pressure distributions, velocity profiles, transition onset, and Reynolds shear stresses for multi-element airfoils is presented. It is shown that the transitional k-zeta model, which is implemented into CFL3D, does a good job of predicting pressure distributions, transition onset, and velocity profiles with the exception of velocities in the slat wake region. Considering the fact that the hot wire used was not fine enough to resolve Reynolds stresses in the boundary layer, comparisons of turbulence stresses varied from good to fair. It is suggested that the effects of unsteadiness be thoroughly evaluated before more complicated transition/turbulence models are used. Further, it is concluded that the present work presents a viable and economical method for calculating laminar/transitional/turbulent flows over complex shapes without user interface.

Author

Airfoils; Pressure Distribution; Velocity Distribution; Reynolds Stress; Boundary Layer Transition

20000029573 NASA Dryden Flight Research Center, Edwards, CA USA

In-Flight Wing Pressure Distributions for the NASA F/A-18A High Alpha Research Vehicle

Davis, Mark C., NASA Dryden Flight Research Center, USA; Saltzman, John A., NASA Dryden Flight Research Center, USA; March 2000; 66p; In English

Contract(s)/Grant(s): RTOP 529-55-24

Report No.(s): NASA/TP-2000-209018; NAS 1.60:209018; H-2389; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Pressure distributions on the wings of the F/A-18A High Alpha Research Vehicle (HARV) were obtained using both flush-mounted pressure orifices and surface-mounted pressure tubing. During quasi-stabilized 1-g flight, data were gathered at ranges for angle of attack from 5 deg to 70 deg, for angle of sideslip from -12 deg to +12 deg, and for Mach from 0.23 to 0.64, at various engine settings, and with and without the leading edge extension fence installed. Angle of attack strongly influenced the wing pressure distribution, as demonstrated by a distinct flow separation pattern that occurred between the range from 15 deg to 30 deg. Influence by the leading edge extension fence was evident on the inboard wing pressure distribution, but little influence was seen on the outboard portion of the wing. Angle-of-sideslip influence on wing pressure distribution was strongest at low angle of attack. Influence of Mach number was observed in the regions of local supersonic flow, diminishing as angle of attack was increased. Engine throttle setting had little influence on the wing pressure distribution.

Author

Wings; Pressure Distribution; Wind Tunnel Tests

20000029610 NASA Langley Research Center, Hampton, VA USA

Sweep and Compressibility Effects on Active Separation Control at High Reynolds Numbers

Seifert, Avi, National Academy of Sciences - National Research Council, USA; Pack, LaTunia G., NASA Langley Research Center, USA; [2000]; 18p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2000-0410; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper explores the effects of compressibility, sweep and excitation location on active separation control at high Reynolds numbers. The model, which was tested in a cryogenic pressurized wind tunnel, simulates the upper surface of a 20% thick Glauert-Goldschmied type airfoil at zero angle of attack. The flow is fully turbulent since the tunnel sidewall boundary layer flows over the model. Without control, the flow separates at the highly convex area and a large turbulent separation bubble is formed.

Periodic excitation is applied to gradually eliminate the separation bubble. Two alternative blowing slot locations as well as the effect of compressibility, sweep and steady suction or blowing were studied. During the test the Reynolds numbers ranged from 2 to 40 million and Mach numbers ranged from 0.2 to 0.7. Sweep angles were 0 and 30 deg. It was found that excitation must be introduced slightly upstream of the separation region regardless of the sweep angle at low Mach number. Introduction of excitation upstream of the shock wave is more effective than at its foot. Compressibility reduces the ability of steady mass transfer and periodic excitation to control the separation bubble but excitation has an effect on the integral parameters, which is similar to that observed in low Mach numbers. The conventional swept flow scaling is valid for fully and even partially attached flow, but different scaling is required for the separated 3D flow. The effectiveness of the active control is not reduced by sweep. Detailed flow field dynamics are described in the accompanying paper.

Author

Sweep Effect; Compressibility; Active Control; Excitation; Wind Tunnel Tests; Separated Flow

20000030677 NASA Langley Research Center, Hampton, VA USA

Low-Speed Investigation of Upper-Surface Leading-Edge Blowing on a High-Speed Civil Transport Configuration

Banks, Daniel W., NASA Langley Research Center, USA; Laflin, Brenda E. Gile, NASA Langley Research Center, USA; Kemmerly, Guy T., NASA Langley Research Center, USA; Campbell, Bryan A., NASA Langley Research Center, USA; December 1999; 62p; In English

Contract(s)/Grant(s): RTOP 537-03-22-02

Report No.(s): NASA/TP-1999-209538; NAS 1.60:209538; L-17483; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The paper identifies speed, agility, human interface, generation of sensitivity information, task decomposition, and data transmission (including storage) as important attributes for a computer environment to have in order to support engineering design effectively. It is argued that when examined in terms of these attributes the presently available environment can be shown to be inadequate. A radical improvement is needed, and it may be achieved by combining new methods that have recently emerged from multidisciplinary design optimisation (MDO) with massively parallel processing computer technology. The caveat is that, for successful use of that technology in engineering computing, new paradigms for computing will have to be developed - specifically, innovative algorithms that are intrinsically parallel so that their performance scales up linearly with the number of processors. It may be speculated that the idea of simulating a complex behaviour by interaction of a large number of very simple models may be an inspiration for the above algorithms; the cellular automata are an example. Because of the long lead time needed to develop and mature new paradigms, development should begin now, even though the widespread availability of massively parallel processing is still a few years away.

Author

Low Speed; High Speed; Civil Aviation; Leading Edges; Aerodynamic Configurations; Wind Tunnel Tests; Upper Surface Blowing

20000030691 Naval Surface Warfare Center, Dahlgren, VA USA

Review and Extension of Computational Methods for Noncircular Cross-Sectional Weapons

Moore, F. G., Naval Surface Warfare Center, USA; McInville, R. M., Naval Surface Warfare Center, USA; Hymer, T. C., Naval Surface Warfare Center, USA; Journal of Spacecraft and Rockets; Septmber-October 1998; Volume 35, No. 5, pp. 585-597; In English; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

A review of current state-of-the-art methods for computing aerodynamics of noncircular cross-sectional weapon concepts has been performed. In addition, an improved engineering method has been developed to compute aerodynamics of these nonaxisymmetric body configurations. The improved method is based on extending current state-of-the-art methods for computing aerodynamics of noncircular wing-body shapes based on circular wing-body methods. Specific additions to the state-of-the-art methods currently in use include extensions to a broader class of cross-sectional bodies and to a higher angle of attack; extensions to allow improved accuracy at low crossflow Mach number and to allow body cross-sectional shape to impact the critical crossflow Reynolds number; and a method to treat wing-body interference factor corrections as a function of body geometry, Mach number, and angle of attack. The new methods were applied to a broad class of noncircular body alone and wing-body configurations for which wind-tunnel data were available. In general, results for normal force, axial force, and center-of-pressure predictions were quite good for a semiempirical methodology, over the Mach number and angle-of-attack range where data were available. Range of variables included Mach numbers as low as 0.3 and as high as 14 and angles of attack to 60 deg.

Author

Cross Flow; Aerodynamic Configurations; Mathematical Models; Weapons; Cross Sections; Computation

20000031245 Technical Univ. of Tallinn, Tallinn, Estonia

The Natural Convection Heat Transfer Phenomana Near The Surface Covered by Riblets

Kaar, Harri, Technical Univ. of Tallinn, Estonia; Neshumajev, Dmitri, Technical Univ. of Tallinn, Estonia; 10th European Drag Reduction Working Meeting: Book of Abstracts; Mar. 24, 1997; 1p; In English; See also 20000031244; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Natural convection experiments were conducted in water, and mercury near the vertical cylindrical surface covered with riblet film (3M Corporation PVC film). The groove orientations were placed both parallel and perpendicular to the flow direction. V-grooves with depths of 75 micrometers were used. The experiments are performed in a range of complex ($Gr \times Pr$ (exp 2)) up to the 3×10 (exp 6) for mercury and in a range of Rayleigh numbers up to the Ra congruent to 1.6×10 (exp 11) for water. As known, the riblets may affect to the formation of vortices in the flow and are able to drag reduction in turbulent flow up to 10% at certain Re numbers. The dependence of heat transfer on riblets orientation in natural convection is not known exactly. Also for natural convection intensity affect the properties of surface material. Some results of measurements of temperature pulsations appeared with the turbulence in medium are shown. The fluctuations are recorded by fast data acquisition interface for PC and presented as the temperature difference between the surface of calorimeter and liquid.

Author

Convective Heat Transfer; Riblets; Surface Layers; Free Convection

20000031262 Technische Univ., FG Bionik and Evolutionstechnik, Berlin, Germany

Flexible Flaps for Separation Control on a Wing with Low Aspect Ratio

Patone, G., Technische Univ., Germany; Mueller, W., Technische Univ., Germany; 10th European Drag Reduction Working Meeting: Book of Abstracts; Mar. 24, 1997; 1p; In English; See also 20000031244; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

As part of a bionics project, an airfoil (NACA 2412) has been tested for its stall behaviour with flexible flaps attached to the upper surface. Analogous to the cover feathers on a bird's wing, the flaps are able to prevent or at least delay the spreading of the eddy from the trailing towards the leading edge of the wing during stall. The experiments were conducted in an open circuit wind tunnel at $Re=120\,000$, with the airfoil having an aspect ratio of 3.5. The NACA 2412 exhibits a sudden drop in generated lift when the angle of attack is increased beyond the critical value. With the appropriate flaps attached, this drop in lift production can be prevented or at least delayed, as the flaps will be lifted off the surface automatically when flow separation commences. It is important to note that the flaps remain smoothly on the surface of the airfoil as long as the angle of attack is below the critical value. Therefore, they have nearly no negative effect on the drag. Best results were obtained using materials of a certain porosity and flexibility. Because of the low aspect ratio of the airfoil used, the flow separation starts from the centre of the airfoil, and thus it is crucial that the flaps can form a pocket. So these flaps can serve as a smart safety device. In order to gain better insights into the aerodynamic mechanism of the flaps, the pressure distribution over the surface of the airfoil was investigated. The results show the effect of the flaps to be a restriction of the separation, so that the remaining part of the airfoil can still generate lift.

Author

Low Aspect Ratio; Flaps (Control Surfaces); Flexibility; Separated Flow; Wind Tunnel Tests; Aerodynamics

20000031265 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen, Germany

Effects of Acoustic Excitation on Flow Separation from a Wing at High Angles of Incidence

Grosche, F.-R., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Kozlov, V. V., Academy of Sciences (USSR), USSR; 10th European Drag Reduction Working Meeting: Book of Abstracts; Mar. 24, 1997; 1p; In English; See also 20000031244; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

This paper concerns wind-tunnel experiments on the control of three-dimensional separation from a wing by external acoustic excitation. Flow visualization techniques were used to study the influence of sound waves on the flow separation from a wing of low aspect ratio 3:1 at Mach numbers M less than or equal to 0.1. Tests were made within the Reynolds number range 6×10 (exp 5) less than or equal to Re less than or equal to 1.2×10 (exp 6), at angles of incidence up to 25 degrees and yaw angles up to 30 degrees. Two different configurations of the acoustic excitation have been applied: 1. Spherical sound waves from a loudspeaker within the acoustic far field (Global excitation) and 2. Sound waves focused by an elliptical mirror on a small region of the wing (Localized excitation).

Author

Acoustic Excitation; Separated Flow; Wings; Wind Tunnel Tests; Angle of Attack

20000031269 Nottingham Univ., Dept. of Mechanical Engineering, UK

Heat-Transfer Characteristics of Drag-Reducing Riblets

Choi, Kwing-So, Nottingham Univ., UK; Orchard, David, Nottingham Univ., UK; 10th European Drag Reduction Working Meeting: Book of Abstracts; Mar. 24, 1997; 1p; In English; See also 20000031244; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The drag reduction capabilities of riblets were extensively researched in the past two decades with detailed results on the near-wall boundary layer structure over the passive device. The associated heat transfer characteristics of the micro-grooved surface were studied only by a handful of researchers, all of which, however, seem to show a large increase in heat-transfer efficiency. In order to study the structure of the thermal boundary layer over the riblet surface and understand the mechanisms responsible for this apparent breakdown of the Reynolds analogy, further investigations into the heat-transfer characteristics of riblets are necessary. In the present study we tried to make an accurate evaluation of the heat-transfer characteristics of slightly-heated riblet surfaces within and just outside its drag reduction regime (s (exp +) less than 60).

Author

Drag Reduction; Riblets; Conductive Heat Transfer

20000031365 NASA Langley Research Center, Hampton, VA USA

Piloted Simulation Study of a Dual Thrust-Cutback Procedure for Reducing High-Speed Civil Transport Takeoff Noise Levels

Riley, Donald R., NASA Langley Research Center, USA; Glaab, Louis J., Lockheed Engineering and Sciences Co., USA; Brandon, Jay M., NASA Langley Research Center, USA; Person, Lee H., Jr., NASA Langley Research Center, USA; Glaab, Patricia C., Unisys Corp., USA; December 1999; 72p; In English

Contract(s)/Grant(s): RTOP 537-03-22-08

Report No.(s): NASA/TP-1999-209698; L-17431; NAS 1.60:209698; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

A piloted simulation study was performed for the purpose of indicating the noise reduction benefits and piloting performance that could occur for a typical 4-engine high-Speed Civil Transport (HSCT) configuration during takeoff when a dual thrust-cutback procedure was employed with throttle operation under direct computer control. Two thrust cutbacks were employed with the first cutback performed while the vehicle was accelerating on the run-way and the second cutback performed at a distance farther downrange. Added vehicle performance improvements included the incorporation of high-lift increments into the aerodynamic database of the vehicle and the use of limited engine oversizing. Four single-stream turbine bypass engines that had no noise suppression of any kind were used with this configuration. This approach permitted establishing the additional noise suppression level that was needed to meet Federal Air Regulation Part 36 Stage 3 noise levels for subsonic commercial jet aircraft. Noise level results were calculated with the jet mixing and shock noise modules of the Aircraft Noise Prediction Program (ANOPP).

Author

Simulation; Takeoff; Aerodynamic Noise; Noise Reduction

20000031532 NASA Langley Research Center, Hampton, VA USA

1998 NASA High-Speed Research Program Aerodynamic Performance Workshop, Volume 1, Configuration Aerodynamics

McMillin, S. Naomi, Editor, NASA Langley Research Center, USA; 1998 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1; 944p; In English, 9-13 Feb. 1998, Los Angeles, CA, USA; Sponsored by NASA Langley Research Center, USA; See also 20000031533 through 20000031552; Original contains color illustrations

Contract(s)/Grant(s): RTOP 537-07

Report No.(s): NASA/CP-1999-209692/VOL1/PT1; NAS 1.55:209692/VOL1/PT1; L-17758A/VOL1/PT1; No Copyright; Avail: CASI; A99, Hardcopy; A10, Microfiche

NASA's High-Speed Research Program sponsored the 1998 Aerodynamic Performance Technical Review on February 9-13, in Los Angeles, California. The review was designed to bring together NASA and industry HighSpeed Civil Transport (HSCT) Aerodynamic Performance technology development participants in areas of. Configuration Aerodynamics (transonic and supersonic cruise drag prediction and minimization), High-Lift, and Flight Controls. The review objectives were to: (1) report the progress and status of HSCT aerodynamic performance technology development; (2) disseminate this technology within the appropriate technical communities; and (3) promote synergy among the scientists and engineers working HSCT aerodynamics. In particular, single and multi-point optimized HSCT configurations, HSCT high-lift system performance predictions, and HSCT simulation results were presented along with executive summaries for all the Aerodynamic Performance technology areas. The

HSR Aerodynamic Performance Technical Review was held simultaneously with the annual review of the following airframe technology areas: Materials and Structures, Environmental Impact, Flight Deck, and Technology Integration. Thus, a fourth objective of the Review was to promote synergy between the Aerodynamic Performance technology area and the other technology areas of the HSR Program.

Author

Aerodynamic Configurations; Aerodynamic Characteristics; Civil Aviation; Performance Prediction; Supersonic Transports; Computational Fluid Dynamics

20000031534 NASA Ames Research Center, Moffett Field, CA USA

Propulsion Airframe Integration Advisory Group Report

Bencze, Dan, NASA Ames Research Center, USA; 1998 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 31-39; In English; See also 20000031532; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A10, Microfiche

This paper presents The Propulsion Airframe Integration Advisory report in viewgraph form. The approach of the advisory group is to identify and prioritize technology elements (1.0 Inlet Issues, 2.0 Nozzle Issues, 3.0 Nacelle Design, and 4.0 Airframe Integration).

CASI

Propulsion; Airframes; Nacelles; Aerodynamic Configurations; Inlet Nozzles

20000031535 NASA Ames Research Center, Moffett Field, CA USA

Cycle 2 Nonlinear Design Optimization Analytical Cross Checks

Bencze, Dan, NASA Ames Research Center, USA; 1998 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 45-73; In English; See also 20000031532; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The objectives of the Cycle 2 Nonlinear Design Optimization Analytical Cross Checks are to: 1) Understand the variability in the predicted performance levels of the nonlinear designs arising from the use of different inviscid (full potential/Euler) and viscous (Navier-Stokes) analysis methods; and 2) Provide the information required to allow the performance levels of all three designs to be validated using the data from the NCV (nonlinear Cruise Validation) model test.

Derived from text

Nonlinearity; Design Analysis; Aerodynamic Configurations; Performance Prediction; Optimization; Airframes

20000031536 NASA Ames Research Center, Moffett Field, CA USA

Airplane Mesh Development with Grid Density Studies

Cliff, Susan E., NASA Ames Research Center, USA; Baker, Timothy J., Princeton Univ., USA; Thomas, Scott D., Sterling Software, Inc., USA; Lawrence, Scott L., NASA Ames Research Center, USA; Rimlinger, Mark J., Sterling Software, Inc., USA; 1998 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 75-145; In English; See also 20000031532; Original contains color illustrations; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

Automatic Grid Generation Wish List Geometry handling, including CAD clean up and mesh generation, remains a major bottleneck in the application of CFD methods. There is a pressing need for greater automation in several aspects of the geometry preparation in order to reduce set up time and eliminate user intervention as much as possible. Starting from the CAD representation of a configuration, there may be holes or overlapping surfaces which require an intensive effort to establish cleanly abutting surface patches, and collections of many patches may need to be combined for more efficient use of the geometrical representation. Obtaining an accurate and suitable body conforming grid with an adequate distribution of points throughout the flow-field, for the flow conditions of interest, is often the most time consuming task for complex CFD applications. There is a need for a clean unambiguous definition of the CAD geometry. Ideally this would be carried out automatically by smart CAD clean up software. One could also define a standard piece-wise smooth surface representation suitable for use by computational methods and then create software to translate between the various CAD descriptions and the standard representation. Surface meshing remains a time consuming, user intensive procedure. There is a need for automated surface meshing, requiring only minimal user intervention to define the overall density of mesh points. The surface mesher should produce well shaped elements (triangles or quadrilaterals) whose size is determined initially according to the surface curvature with a minimum size for flat pieces, and later refined by the user in other regions if necessary. Present techniques for volume meshing all require some degree of user intervention. There is a need for fully automated and reliable volume mesh generation. In addition, it should be possible to create

both surface and volume meshes that meet guaranteed measures of mesh quality (e.g. minimum and maximum angle, stretching ratios, etc.).

Derived from text

Grid Generation (Mathematics); Computational Fluid Dynamics; Computer Aided Design; Aircraft; Density (Mass/Volume)

20000031537 NASA Langley Research Center, Hampton, VA USA

High Reynolds Number Predictions for the Baseline Arrow Wing at Mach 2.48

Rivers, Melissa, NASA Langley Research Center, USA; Wahls, Richard, NASA Langley Research Center, USA; 1998 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 147-169; In English; See also 20000031532; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The NASA High Speed Research (HSR) Program is intended to establish a technology base enabling industry development of an economically viable and environmentally acceptable second generation high speed civil transport (HSCT). The objective of the Configuration Aerodynamics task of the program is the development of aerodynamic drag reduction, stability and control, and propulsion airframe integration technologies required to support the HSCT development process. Aerodynamic design tools are being developed, evaluated, and validated through ground based experimental testing. In addition, methods for ground to flight scaling are being developed and refined.

Author

High Reynolds Number; Mach Number; Arrow Wings; Aerodynamic Configurations; High Speed; Civil Aviation; Computational Fluid Dynamics

20000031538 NASA Langley Research Center, Hampton, VA USA

Applications of Parallel Processing in Configuration Analyses

Sundaram, Ppchuraman, Boeing Co., USA; Hager, James O., Boeing Co., USA; Biedron, Robert T., NASA Langley Research Center, USA; 1998 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 171-203; In English; See also 20000031532; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The paper presents the recent progress made towards developing an efficient and user-friendly parallel environment for routine analysis of large CFD problems. The coarse-grain parallel version of the CFL3D Euler/Navier-Stokes analysis code, CFL3Dhp, has been ported onto most available parallel platforms. The CFL3Dhp solution accuracy on these parallel platforms has been verified with the CFL3D sequential analyses. User-friendly pre- and post-processing tools that enable a seamless transfer from sequential to parallel processing have been written. Static load balancing tool for CFL3Dhp analysis has also been implemented for achieving good parallel efficiency. For large problems, load balancing efficiency as high as 95% can be achieved even when large number of processors are used. Linear scalability of the CFL3Dhp code with increasing number of processors has also been shown using a large installed transonic nozzle boattail analysis. To highlight the fast turn-around time of parallel processing, the TCA full configuration in sideslip Navier-Stokes drag polar at supersonic cruise has been obtained in a day. CFL3Dhp is currently being used as a production analysis tool.

Author

Parallel Processing (Computers); Computational Fluid Dynamics; Aerodynamic Configurations; Navier-Stokes Equation; Applications Programs (Computers)

20000031540 NASA Langley Research Center, Hampton, VA USA

Unstructured Grid Euler Method Assessment for Aerodynamics Performance Prediction of the Complete TCA Configuration at Supersonic Cruise Speed

Ghaffari, Farhad, NASA Langley Research Center, USA; 1998 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 287-308; In English; See also 20000031532; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

Unstructured grid Euler computations, performed at supersonic cruise speed, are presented for a proposed high speed civil transport configuration, designated as the Technology Concept Airplane (TCA) within the High Speed Research (HSR) Program. The numerical results are obtained for the complete TCA cruise configuration which includes the wing, fuselage, empennage, diverters, and flow through nacelles at Mach 2.4 for a range of angles-of-attack and sideslip. The computed surface and off-surface flow characteristics are analyzed and the pressure coefficient contours on the wing lower surface are shown to correlate reasonably well with the available pressure sensitive paint results, particularly, for the complex shock wave structures around the nacelles. The predicted longitudinal and lateral/directional performance characteristics are shown to correlate very well with the measured

data across the examined range of angles-of-attack and sideslip. The results from the present effort have been documented into a NASA Controlled-Distribution report which is being presently reviewed for publication.

Author

Unstructured Grids (Mathematics); Euler Equations of Motion; Performance Prediction; Supersonic Speed; Aerodynamic Configurations; Computational Fluid Dynamics; Civil Aviation

20000031541 NASA Langley Research Center, Hampton, VA USA

Unstructured Navier-Stokes Analysis of Full TCA Configuration

Frink, Neal T., NASA Langley Research Center, USA; Pirzadeh, Shahyar Z., NASA Langley Research Center, USA; 1998 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 309-327; In English; See also 20000031532; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

This paper presents an Unstructured Navier-Stokes Analysis of Full TCA (Technology Concept Airplane) Configuration. The topics include: 1) Motivation; 2) Milestone and approach; 3) Overview of the unstructured-grid system; 4) Results on full TCA W/B/N/D/E configuration; 5) Concluding remarks; and 6) Future directions.

CASI

Navier-Stokes Equation; Unstructured Grids (Mathematics); Aerodynamic Configurations; Supersonic Transports; Computational Fluid Dynamics; Applications Programs (Computers)

20000031542 NASA Ames Research Center, Moffett Field, CA USA

Skin Friction Drag Predictions: Summary of CFD Cross Checks, Wing/Body

Lawrence, Scott, NASA Ames Research Center, USA; Klopfer, Goetz, NASA Ames Research Center, USA; 1998 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 333-353; In English; See also 20000031532; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The objective of the present study was to address the questions of: 1) how reliably or consistently the Navier-Stokes methods and processes used by the various organizations can predict integrated skin friction drag, and 2) how well the methods can predict trends within a family of optimized configurations. As a first step, all available skin friction drag predictions were accumulated to obtain a mean and standard deviation for the TCA (Technology Concept Airplane) baseline and each of the optimized configurations. It is observed that the optimization process has had little effect on the predicted skin friction drags. The variation in the mean that is observed is dwarfed by the standard deviations. In order to understand the reasons for the relatively large spreads in the computed results, a number of auxiliary computations have been performed using the UPS and OVERFLOW codes in an effort to identify and quantify potential sources of the variations.

Author

Skin Friction; Computational Fluid Dynamics; Body-Wing Configurations; Aerodynamic Drag; High Speed; Civil Aviation

20000031543 DYNACS Engineering Co., Inc., Renton, WA USA

TCA and Symmetric Model Viscous Drag Predictions

Kandula, Max, DYNACS Engineering Co., Inc., USA; 1998 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 355-425; In English; See also 20000031532; Original contains color illustrations; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

A CFD analysis with the OVERFLOW code was carried out to determine the viscous drag for the symmetric TCA wing/body configuration (angle of attack $\alpha=0$ deg) at wind tunnel Reynolds number (Mach 0.7 through 2.4) and at flight Reynolds number (Mach 0.9 through 2.4). Detailed local and chordwise averaged skin friction coefficients were computed at two selected Mach numbers ($M=0.9$ and 2.4). The predicted viscous drag, local and averaged skin friction coefficients were compared with the flat plate theories (based on two-dimensional boundary layer theories) of Sommer-Short and Frankl-Voishel. Skin friction coefficients were evaluated for the baseline TCA (Technology Concept Aircraft) configuration at $M=0.9$ and $M=2.4$ at both flight and wind tunnel Reynolds number and corresponding to cruise angles of attack. The purpose of the study was to establish the accuracy of the flat plate skin friction theories for HSCT (High Speed Civil Transport) applications.

Author

Viscous Drag; Performance Prediction; Computational Fluid Dynamics; Symmetry; Civil Aviation; Supersonic Speed; Turbulence Models

20000031544 Boeing Co., Long Beach, CA USA

Feasibility Study of a TCA Symmetric Model for Accurate Skin-Friction Measurements

Mendoza, Raul, Boeing Co., USA; Sundaram, Pichuraman, Boeing Co., USA; 1998 NASA High-Speed Research Program

Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 427-475; In English; See also 20000031532; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

Computational results from different CFD codes have been observed to produce significant differences in viscous drag predictions for HSCT configurations. Therefore, the HSR Configuration Aerodynamics (CA) community has proposed testing a TCA symmetric model in an effort to obtain wind-tunnel data useful in the validation of Navier-Stokes viscous drag predictions. This paper presents some initial computations to assess the feasibility of such a model and help define an appropriate test program.

Author

Feasibility; Computational Fluid Dynamics; Skin Friction; Supersonic Transports; Wind Tunnel Tests; Aerodynamic Configurations; Symmetry

20000031545 Boeing Commercial Airplane Co., Seattle, WA USA

Historic Background on Flat Plate Turbulent Flow Skin Friction and Boundary Layer Growth

Kulfan, Robert M., Boeing Commercial Airplane Co., USA; 1998 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, No. 1, pp. 477-513; In English; See also 20000031532; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

Recent CFD validation studies have shown significant variations in viscous drag predictions between the various methods used by the NASA and industry HSCT organizations. The methods include Navier Stokes CFD codes in which the viscous forces are part of the solutions, and predictions obtained from the different fully turbulent flow flat plate skin friction drag equations used by the various organizations. The initial objective of this study was to provide an experimental database of fully turbulent flow skin friction measurements on flat plate adiabatic surfaces at subsonic through supersonic Mach numbers and for a wide range of Reynolds numbers. The database could then be used as the initial step in resolving the differences in the viscous predictions. This database, was originally assembled in 1960 from selected experiments conducted prior to that time period. The criteria used to select the appropriate test data are described in the reference. Data were also found on turbulent boundary layer velocity profiles and it was therefore possible to analyze other boundary layer properties such as shape factor, displacement thickness and boundary layer thickness. The data presented in this note was scanned from the figures in the report and then digitized using a highly accurate PC screen digitizer. The digitized data will be released in a report early in 1998. In the process of extracting the data, statistical analyses were made between the test data and the corresponding predictions of various fully turbulent flat plate skin friction prediction methods. An improved method of predicting compressible turbulent skin friction drag was developed. Boundary layer profile data measurements are also included along with a new method for predicting boundary layer growth characteristics. These include approximate velocity profile representation, boundary displacement thickness, and boundary layer thickness.

Author

Civil Aviation; Computational Fluid Dynamics; Flat Plates; Skin Friction; Supersonic Speed; Turbulent Flow; Turbulent Boundary Layer

20000031546 NASA Ames Research Center, Moffett Field, CA USA

CA Testing Workshops: Process, Issues, Results

Kennelly, Robert A., Jr., NASA Ames Research Center, USA; 1998 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 515-537; In English; See also 20000031532; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

This presentation will describe the organization and conduct of the workshops, list the topics discussed, and conclude with a more-detailed examination of a related set of issues dear to the presenters heart. Because the current HSCT configuration is expected to have (mostly) turbulent flow over the wings, and because current CFD predictions assume fully-turbulent flow, the wind tunnel testing to date has attempted to duplicate this condition at the lower Reynolds numbers attainable on the ground. This frequently requires some form of artificial boundary layer trip to induce transition near the wing's leading edge. But this innocent-sounding goal leads to a number of complications, and it is not clear that present-day testing technology is adequate to the task. An description of some of the difficulties, and work underway to address them, forms the "Results" section of this talk. Additional results of the testing workshop will be covered in presentations by other team members.

Author

Aerodynamic Configurations; Presentation; Teams; Supersonic Transports; Wind Tunnel Tests; Conferences

20000031547 NASA Langley Research Center, Hampton, VA USA

High Reynolds Number Assessment of Boundary Layer Transition Trip Drag at Mach 2.48 on HSCT Configuration

Wahls, Richard, NASA Langley Research Center, USA; Rivers, Melissa, NASA Langley Research Center, USA; Magee, Todd, Boeing Co., USA; Novean, Michael, Boeing Co., USA; 1998 NASA High-Speed Research Program Aerodynamic Performance

Workshop; December 1999; Volume 1, Part 1, pp. 539-569; In English; See also 20000031532; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The NASA High Speed Research (HSR) Program is intended to establish a technology base enabling industry development of an economically viable and environmentally acceptable second generation high speed civil transport (HSCT). The HSR program consists of work directed towards several broad technology areas, one of which is aerodynamic performance. The objective of the Configuration Aerodynamics task of the Aerodynamic Performance technology area is the development of aerodynamic drag reduction, stability and control, and propulsion airframe integration technologies required to support the HSCT development process. Towards this goal, computational and empirical based aerodynamic design tools are being developed, evaluated, and validated through ground based experimental testing. In addition, methods for ground to flight scaling are being developed and refined. Successful development of validated design and scaling methodologies will result in improved economy of operation for an HSCT and reduce uncertainty in full-scale flight predictions throughout the development process.

Author

High Reynolds Number; Boundary Layer Transition; Mach Number; Supersonic Transports; Aerodynamic Configurations; Drag Reduction; Computational Fluid Dynamics

20000031548 Boeing Co., Long Beach, CA USA

Experimental Bias and Precision Errors: Requirements, Analysis, and Recommendations

Novean, Michael G. B., Boeing Co., USA; Magee, Todd E., Boeing Co., USA; 1998 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 571-619; In English; See also 20000031532; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

Tight error bars on experimental data are required in order to meet HSCT (High Speed Civil Transport) performance requirements. This paper aims to deal with the need for these requirements and their impact upon desired testing accuracy. The definition of some terminology sets the stage for a brief review of how some of the accuracy requirements were generated. Error analyses or estimates from many of the wind tunnels used in HSR testing are presented. The sensitivity of performance coefficients to selected instrumentation accuracies is discussed. Uncertainties due to data corrections are acknowledged as another source of error. Future improvements to both facilities and test processes are suggested.

Author

Bias; Error Analysis; Precision; Supersonic Transports; Wind Tunnel Tests; Data Processing

20000031549 Boeing Co., Long Beach, CA USA

BCAG Design Optimization Activities

Conner, Roy S., Boeing Co., USA; 1998 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 625-692; In English; See also 20000031532; Original contains color illustrations; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

The goal of this activity is the development and evaluation of multi-point optimization. The current task is limited to the high speed flight regime, subsonic cruise to supersonic cruise, and is based on the use of contemporary nonlinear aerodynamic tools. It is important to understand that the goal is more than a tool, the goal is a process. Tool building is part of the effort, but the result of the process building is the goal. Since multi-point optimization trades the aerodynamic efficiencies of multiple, disparate flight conditions, it appears that now is the time to begin optimizing to trimmed drag. The magnitude of trim drag at the conditions of interest for multi-point optimization is a significant fraction of the drag improvements due to nonlinear optimization itself. Multi-point optimization will require significant resources. The result of this major expenditure of resources will be far more meaningful if the exercise is based on trimmed drags. Longitudinal trim dictates that the empennage be added to the optimization model. Only complete configurations are acceptable. With the advent of the PTC configuration and through discussions with TI it also appears that for the foreseeable future complete configurations will include a canard. The one significant non-aerodynamic contributor to longitudinal trim is engine thrust forces. This will also be included. Another part of the overall goal of multi-point optimization is to include viscous effects wherever beneficial and/or necessary. The final, and perhaps most significant aspect of the goal of multi-point optimization is an understanding of who real customer is and how they will use the capability. The real customer will be the configuration designers working on the actual preliminary design of the actual airplane development program, somewhere in the future, sometime after HSR. More detail on how the process will be used on the airplane program and the implications of that use will be given later.

Author

Optimization; Design Analysis; Boeing Aircraft; Aerodynamic Configurations

20000031550 Research Inst. for Advanced Computer Science, Moffett Field, CA USA

SYN107-MB Aerodynamic Shape Optimization Method: Recent Improvements and Current Status

Reuther, James, Research Inst. for Advanced Computer Science, USA; Rimlinger, Mark, Sterling Software, Inc., USA; Saunders, David, Sterling Software, Inc., USA; Hicks, Raymond, MCAT Inst., USA; 1998 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 693-775; In English; See also 20000031532; No Copyright; Avail: CASI; A05, Hardcopy; A10, Microfiche

This presentation provides an overview of the improvements and developments that have been incorporated into the aerodynamic optimization capability at NASA Ames Research Center. The main Aerodynamic Shape Optimization (ASO) tool, SYN 107-MB, will be discussed with attention to enhancements over the past year. The topics covered are: 1) Preliminary Navier-Stokes Design Capability (SYN107-MB); 2) AEROSURF Geometry Interface; 3) Improvements in Multiblock Mesh Motion; 4) Improvements in Parallel Performance and Communication; 5) Gradient Checks for Transonic Flows; 6) Gradient Checks for Supersonic Flows; 7) Navier-Stokes-Based constrained Design Example; and 8) Future Developments.

CASI

Aerodynamic Configurations; Optimization; Applications Programs (Computers); Software Development Tools; Navier-Stokes Equation; Design Analysis

20000031551 Boeing Co., Long Beach, CA USA

The Aeroshop Toolkit (AERodynamic Shape Optimization)

Unger, Eric R., Boeing Co., USA; Narducci, Robert P., Boeing Co., USA; Hager, James O., Boeing Co., USA; Hartwich, Peter M., Boeing Co., USA; Mendoza, Raul, Boeing Co., USA; Kuruvila, Geojoe, Boeing Co., USA; 1998 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 777-835; In English; See also 20000031532; Original contains color illustrations; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

This paper is an overview of the capabilities and structure of BLB's new AEROSHOP design toolkit. The development of this code has taken place over the past year leveraging key components of previous work in Configuration Aerodynamics (CA) at Boeing Long Beach (BLB), and new tools developed in the High-Lift element. AEROSHOP is a versatile tool that will be used for all of BLB's CA optimization work. Also presented here is a sample cross-section of some of the recent optimization experiences using AEROSHOP on various problems from transonic flap optimization to integrated wing/body/nacelle/diverter/empennage design. The code is continuously being enhanced to extend its capabilities to configurations with canards, evaluating design sensitivities in a production mode using alternative methods, and fully exploiting parallel processing.

Author

Aerodynamic Configurations; Optimization; Software Development Tools; Aircraft Design; Applications Programs (Computers)

20000031552 MCAT Inst., Moffett Field, CA USA

TCA6 Configuration Optimization

Hicks, Raymond, MCAT Inst., USA; Rimlinger, Mark, Sterling Software, Inc., USA; Reuther, James, Research Inst. for Advanced Computer Science, USA; 1998 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 837-927; In English; See also 20000031532; No Copyright; Avail: CASI; A05, Hardcopy; A10, Microfiche

This report describes the status of two optimization studies in configuration design using the TCA6 baseline and the Ames optimized geometry (970103). The first study discussed will be flap/slat optimization using SYN87 with a single block grid with finite difference and adjoint gradients at Mach 0.90 and an angle of attack of 4.0 degrees. The second study presented is a preliminary comparison of the improvement in the lift/drag ratio obtainable with axisymmetric and bifurcated inlets on the TCA6 baseline configuration. The flap/slat optimization study was conducted in three phases. Four arbitrarily chosen high lift devices were examined during phase 1. Flap and slat deflections were accomplished by vertical shear and both inboard and outboard flaps and slats of constant percent chord were explored. The inboard and outboard ends of the high lift devices were aligned with the free stream direction and gaps were not modeled. Flap and slat ends and edges blended smoothly into the wing. The second phase of the study involved the use of approximate geometry of the outboard flap and slat of the TCA6 wind tunnel model. The slat used during this phase had a constant chord of 26% of the local wing chords while the flap had a constant chord of 22% of the local wing chords. Both high lift devices had the same span as the wind tunnel model. Deflections were again accomplished by using vertical shear. The third phase used an improved grid with better cell aspect ratios in critical areas of the computational space and rotation instead of shear was used for deflections. The outboard slat for this phase had the same linearly varying chord lengths as the wind tunnel model. All flap/slat studies were conducted using SYN87SB. Preliminary results from an optimization study conducted to determine whether axisymmetric or bifurcated inlets give better improvement in the lift-drag ratio for the TCA6 Baseline configuration will also be presented. This study used the multi-block Euler/Navier-Stokes design code SYN107MB in

Euler mode. The results presented here cannot be considered definitive since a major limitation in the design code was found early in the optimization process which prevented further progress. At the time of this writing in late January the code had not been fixed so the results shown will be approximately one month old. However, the data comparisons for the two inlet types presented is considered to be valid and is probably an indication of the final outcome of the study.

Author

Aerodynamic Configurations; Optimization; Flapping; Wind Tunnel Models; Computational Fluid Dynamics

20000031646 Purdue Univ., School of Aeronautics and Astronautics, West Lafayette, IN USA

Laminar-Turbulent Transition in High-Speed Compressible Boundary Layers: Continuation of Elliptic-Cone Experiments *Final Report, 15 Nov. 1996-14 Nov. 1999*

Schneider, Steven P.; Collicott, Steven H.; Jan. 31, 2000; 9p; In English

Contract(s)/Grant(s): F49620-97-1-0037

Report No.(s): AD-A373478; AFRL-SR-BL-TR-00-0026; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This grant supported experimental research into high-speed laminar-turbulent transition. While it began as a one-year effort extending our earlier work on elliptic cones, it became increasingly evident that the low quiet Reynolds number available in the Mach-4 quiet Ludwig tube was limiting the usefulness of the measurements. Although useful results for instability and transition were nevertheless obtained, the emphasis shifted toward development of a high Reynolds number Mach-6 quiet Ludwig tube. Instrumentation development also continued, in the form of a series of experiments carried out at low quiet Reynolds number in the existing Mach-4 Ludwig tube. Experiments with the laser perturber, glow perturber, hot wire, laser-differential interferometer, and hot films are summarized. These experiments were carried out on elliptic cones, round cones, and a scramjet-inlet model.

DTIC

Boundary Layer Transition; Compressible Flow; Supersonic Flow; Boundary Layer Flow; Hypersonic Flow; Transition Flow

20000031776 Research Inst. of National Defence, Weapons and Protection Div., Tumba, Sweden

Large Eddy Simulation of Supersonic Base Flow *Topical Report Storvirvelsimulering av Supersoniskt Basfloede*

Fureby, C.; Nilsson, Y.; Andersson, K.; Feb. 1999; ISSN 1104-9154; 32p; In English

Report No.(s): PB2000-103076; FOA-R-99-01043-310-SE; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

Flow separation at the base of aerodynamic vehicles such as missiles, rockets and projectiles leads to the formation of a low-speed recirculation zone near the base. In this study, a computational capability based on a Large Eddy Simulation (LES) approach has been developed for predicting the flow around axisymmetric aerodynamic vehicles. In particular, the authors have focused on turbulent supersonic base flow over a cylindrical afterbody, with and without base bleed, corresponding to laboratory experiments as to allow direct comparison for a case with zero base bleed, whilst further simulations with base bleed have been undertaken with the best performing subgrid model. Details of first and second order statistical quantities are presented and compared with experimental data. In general, good qualitative agreement is found whilst only good quantitative agreement is reached for the first order statistical moments, with the exception of the near wake region in which both good qualitative and quantitative agreement is achieved.

NTIS

Large Eddy Simulation; Supersonic Flow; Base Flow

20000032094 NASA Langley Research Center, Hampton, VA USA

Wake Vortex Transport and Decay in Ground Effect: Vortex Linking with the Ground

Proctor, Fred H., NASA Langley Research Center, USA; Hamilton, David W., NASA Langley Research Center, USA; Han, Jongil, North Carolina State Univ., USA; [2000]; 15p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2000-0757; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

Numerical simulations are carried out with a three-dimensional Large-Eddy Simulation (LES) model to explore the sensitivity of vortex decay and transport in ground effect (IGE). The vortex decay rates are found to be strongly enhanced following maximum descent into ground effect. The nondimensional decay rate is found to be insensitive to the initial values of circulation, height, and vortex separation. The information gained from these simulations is used to construct a simple decay relationship. This relationship compares well with observed data from an IGE case study. Similarly, a relationship for lateral drift due to ground effect is constructed from the LES data. In the second part of this paper, vortex linking with the ground is investigated. Our numerical simulations of wake vortices for IGE show that a vortex may link with its image beneath the ground, if the intensity of the ambient turbulence is moderate to high. This linking with the ground (which is observed in real cases) gives

the appearance of a vortex tube that bends to become vertically oriented and which terminates at the ground. From the simulations conducted, the linking time for vortices in the free atmosphere; i.e., a function of ambient turbulence intensity.

Author

Vortices; Ground Effect (Aerodynamics); Aircraft Wakes

20000032182 NASA Langley Research Center, Hampton, VA USA

Contributions of the Langley Transonic Dynamics Tunnel to Rotorcraft Technology and Development

Yeager, William T., Jr., Army Research Lab., USA; Kvaternik, Raymond G., NASA Langley Research Center, USA; [2000]; 60p; In English; Dynamics Specialists, 5-6 Apr. 2000, Atlanta, GA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2000-1771; Copyright Waived; Avail: CASI; A04, Hardcopy; A01, Microfiche

A historical account of the contributions of the Langley Transonic Dynamics Tunnel (TDT) to rotorcraft technology and development since the tunnel's inception in 1960 is presented. The paper begins with a summary of the major characteristics of the TDT and a description of the unique capability offered by the TDT for testing aeroelastic models by virtue of its heavy gas test medium. This is followed by some remarks on the role played by scale models in the design and development of rotorcraft vehicles and a review of the basic scaling relationships important for designing and building dynamic aeroelastic models of rotorcraft vehicles for testing in the TDT. Chronological accounts of helicopter and tiltrotor research conducted in the TDT are then described in separate sections. The discussions include a description of the various models employed, the specific objectives of the tests, and illustrative results.

Author

Transonic Wind Tunnels; Aeroelasticity; Rotary Wing Aircraft; Scale Models

20000032313 North Carolina Agricultural and Technical State Univ., NASA CAR, Greensboro, NC USA

Incompressible Turbulent Wing-Body Junction Flow

Krishnamurthy, R., North Carolina Agricultural and Technical State Univ., USA; Cagle, Corey D., North Carolina Agricultural and Technical State Univ., USA; Chandra, S., North Carolina Agricultural and Technical State Univ., USA; NASA University Research Centers Technical Advances in Aeronautics, Space Sciences and Technology, Earth Systems Sciences, Global Hydrology, and Education; Feb. 22, 1998; Volumes 2 and 3, pp. 301-305; In English; See also 20000032189

Contract(s)/Grant(s): NAG3-1734

Report No.(s): 98URC055; No Copyright; Avail: CASI; A01, Hardcopy; A10, Microfiche; C01, CD-ROM

The overall objective of this study is to contribute to the optimized design of fan bypass systems in advanced turbofan engines. Increasing the engine bypass ratios have provided a major boost in engine performance improvement over the last fifty years. An engine with high bypass ratio (11-16:1) such as the Advanced Ducted Propulsion (ADP) is being developed and is expected to provide an additional 25% improvement in overall efficiency over the early turbofans. Such significant improvements in overall efficiency would reduce the cost per seat mile, which is a major government and industry challenge for the 21st century. The research is part of the Advanced Subsonic Technology (AST) program that involves a NASA, U.S. industry and FAA partnership with the goal of a safe and highly productive global air transportation system. The immediate objective of the study is to perform numerical simulation of duct-strut interactions to elucidate the loss mechanisms associated with this configuration that is typical of advanced turbofan engines such as ADP. However, at present experimental data for a duct-strut configuration are not available. Thus, as a first step a wing-body junction flow would be studied and is the specific objective of the present study. At the outset it is to be recognized that while duct-strut interaction flow is similar to that of wing-body junction flows, there are some differences owing to the presence of a wall at both ends of the strut. Likewise, some differences are due to the sheared inflow (as opposed to a uniform inflow) velocity profile. It is however expected that some features of a wing-body junction flow would persist. Next, some of the salient aspects of the complex flow near a wing-body junction, as revealed by various studies reported in the literature will be reviewed. One of the principle characteristics of the juncture flow, is the presence of the mean flow components in a plane perpendicular to the direction of the oncoming free-stream flow. The lateral curvature of the wing/strut causes the oncoming turbulent layer to skew about an axis (x-axis) parallel to the plane (xz-plane) of the mean shear. This is the principle mechanism for the generation of secondary flow. Such skew-induced secondary flows are slow to be attenuated by Reynolds stresses. Additional contribution to the generation of secondary flow comes from anisotropies in Reynolds stresses. Upstream of the strut, the mean-vorticity is directed span wise (along the y-direction). The presence of secondary flow in the vicinity of the strut causes the vorticity to stretch around the obstacle in a horse-shoe shape, with each leg having a vorticity of the opposite sense. The blockage effect of the strut imposes a severe adverse pressure gradient on the oncoming turbulent shear layer, causing boundary layer separation ahead of the leading edge, resulting in a vortex that rolls up and flows downstream into the juncture region. The separation vortices trailing in the wake of the wing can alter the lift or drag characteristics of the surfaces downstream of the

wing-body juncture. Likewise, on submarines, the wake flow behind the appendage can degrade the performance of the propeller located downstream. The complex nature of this flow is caused by the presence of all six components of Reynolds stresses. Devenport and Simpson report that in the vicinity of the horse-shoe vortex there is intense recirculation with turbulent stresses being much larger than those normally observed in turbulent flows. These features contribute to making this flow a challenge to predict numerically. Some of the past studies provide useful insights into this flow that would guide our numerical efforts. In measurements reported by Shabaka and Bradshaw, the eddy viscosity tensor is seen to be non-isotropic and has negative components in certain regions. In an effort to evaluate the closure assumptions of various turbulence models, Devenport and Simpson used their own extensive measurements in juncture flows around the nose of a wing-body junction. Measured values of mean-velocity and/or turbulence kinetic energy was used to predict the magnitude of the shear stress vector. Algebraic stress models performed the best followed by Cebeci-Smith eddy viscosity model. The flow is reported to be dominated by a pressure field produced by the wing and the velocity field generated by the horseshoe vortex that is wrapped around the junction between the wing and wall. Kubendran et al. conclude from an experimental study that the shape of leading edge of the wing as characterized by its slenderness ratio is a major factor in determining the flow fields in the juncture region. The more thinner the leading edge of the juncture, the weaker the horseshoe vortex is. Also, with a slender leading edge, the secondary flow in the juncture would be due mainly to the cross-stream gradients of Reynolds stresses rather than due to a lateral skewing of the shear layer.

Derived from text

Body-Wing Configurations; Incompressible Flow; Free Flow; Pressure Gradients; Secondary Flow; Turbofan Engines; Turbulent Flow; Wakes; Bypass Ratio; Turbofans

20000032455 Virginia Polytechnic Inst. and State Univ., Mechanical Engineering Dept., Blacksburg, VA USA

Effects of Flow Control on the Aerodynamics of a Tandem Inlet Guide Vane

Vandeputte, Thomas W., Virginia Polytechnic Inst. and State Univ., USA; Jan. 19, 2000; 98p; In English

Contract(s)/Grant(s): NAG3-2191; Copyright; Avail: Issuing Activity

An aerodynamic investigation was performed to assess the effectiveness of combined boundary layer suction and trailing edge blowing at reducing the blade profile losses and the wake momentum deficit of a cascade of tandem Inlet Guide Vane's (IGV's) operating at realistic flow conditions. Two trailing edge blowing designs were tested: metal-angle blowing, which oriented the blowing jets very near to the blade exit angle, and deviation-angle blowing, which oriented the blowing jets at a significant deviation angle from the blade exit angle. Both blowing designs used the same boundary layer suction arrangement. A linear cascade of five IGV's was tested with a flap deflection angle of 40 deg and an inlet Mach number of 0.3. The Reynolds number based on the overall IGV chord length for these experiments was greater than 500,000. The inlet and exit angles of the IGV at this flap setting were 0° and 55 deg respectively. Tests performed with no flow control showed significant suction surface flow separation that generated large wakes with high losses and large momentum deficits. The application of boundary layer suction reduced the baseline pressure loss coefficient and wake momentum thickness by 22%. A suction mass flow of 0.4 % of the passage flow was used to obtain these results. The addition of metal-angle blowing with the suction resulted in total reductions of 48 % and 38 % for the pressure loss coefficient and wake momentum thickness. A blowing mass flow of 3.1 % of the passage flow was used in addition to 0.4 % suction mass flow to obtain these results. The application of the deviation-angle blowing was detrimental to the aerodynamics of the IGV, as both the pressure loss coefficient and wake momentum thickness increased slightly over their suction-only values. This was attributed to a manufacturing defect which distorted the flow of the blowing jet. The results of the deviation-angle blowing experiments were not considered representative of the design intent and reinforced the importance of the hole design for creating a proper blowing jet. While low speed tests of this cascade showed results and trends very similar to those of previous research, the application of flow control proved to be less effective at higher speeds due to the generation of significantly larger wakes.

Author

Flow Characteristics; Aerodynamics; Inlet Flow; Boundary Layer Separation; Trailing Edges; Blowing; Deflection; Performance Tests; Guide Vanes; Intake Systems

20000032523 NASA Glenn Research Center, Cleveland, OH USA

A Numerical Evaluation of Icing Effects on a Natural Laminar Flow Airfoil

Chung, James J., Institute for Computational Mechanics in Propulsion, USA; Addy, Harold E., Jr., NASA Glenn Research Center, USA; January 2000; 20p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 548-20-23

Report No.(s): NASA/TM-2000-209775; NAS 1.15:209775; AIAA Paper 2000-0096; E-12055; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

As a part of CFD code validation efforts within the Icing Branch of NASA Glenn Research Center, computations were performed for natural laminar flow (NLF) airfoil, NLF-0414, with 6 and 22.5 minute ice accretions. Both 3-D ice castings and 2-D machine-generated ice shapes were used in wind tunnel tests to study the effects of natural ice as well as simulated ice. They were mounted in the test section of the Low Turbulence Pressure Tunnel (LTPT) at NASA Langley that the 2-dimensionality of the flow can be maintained. Aerodynamic properties predicted by computations were compared to data obtained through the experiment by the authors at the LTPT. Computations were performed only in 2-D and in the case of 3-D ice, the digitized ice shape obtained at one spanwise location was used. The comparisons were mainly concentrated on the lift characteristics over Reynolds numbers ranging from 3 to 10 million and Mach numbers ranging from 0.12 to 0.29. WIND code computations indicated that the predicted stall angles were in agreement with experiment within one or two degrees. The maximum lift values obtained by computations were in good agreement with those of the experiment for the 6 minute ice shapes and the minute 3-D ice, but were somewhat lower in the case of the 22.5 minute 2-D ice. In general, the Reynolds number variation did not cause much change in the lift values while the variation of Mach number showed more change in the lift. The Spalart-Allmaras (S-A) turbulence model was the best performing model for the airfoil with the 22.5 minute ice and the Shear Stress Turbulence (SST) turbulence model was the best for the airfoil with the 6 minute ice and also for the clean airfoil. The pressure distribution on the surface of the iced airfoil showed good agreement for the 6 minute ice. However, relatively poor agreement of the pressure distribution on the upper surface aft of the leading edge horn for the 22.5 minute ice suggests that improvements are needed in the grid or turbulence models.

Author

Ice Formation; Laminar Flow Airfoils; Wind Tunnel Tests; Computational Fluid Dynamics; Mathematical Models; Aerodynamic Characteristics

20000032567 Office National d'Etudes et de Recherches Aerospatiales, Chatillon, France

Performance prediction and flow-field analysis of rotors in hover using a coupled Euler/boundary layer method

Beaumier, P.; Castellin, C.; Arnaud, G.; Dec. 31, 1998; 15p; In English; 24th; European rotor-craft forum

Report No.(s): DE99-765497; ONERA-TP-1998-190; No Copyright; Avail: Department of Energy Information Bridge

The performance prediction of helicopter in hover is of key importance for manufacturers because hover is a design configuration for the definition of a rotor-craft. A lot of efforts have been made for more than 10 years all over the world in order to develop and validate numerical methods based on CFD. An Euler method (WAVES) developed by ONERA and coupled with a boundary layer code (MI3DI) is presented, validated and applied to compute the total performance of rotors with different tip shapes. A new boundary condition for the Euler code has been tested and enables better calculation by eliminating 'numerical' recirculation. The code has demonstrated its ability to rank two rotors with different planforms in good agreement with experiment. Under industrial requirements new grid strategies have been studied and should allow to reduce CPU time consumption. It is shown that WAVES/MI3DI can be efficiently used in the aerodynamic design process of a new rotor.

NTIS

Performance Prediction; Flow Distribution; Rotors; Helicopters

20000032580 NASA Langley Research Center, Hampton, VA USA

Test-to-Test Repeatability of Results From a Subsonic Wing-Body Configuration in the National Transonic Facility

Mineck, Raymond E., NASA Langley Research Center, USA; Pendergraft, Odis C., Jr., NASA Langley Research Center, USA; March 2000; 81p; In English

Contract(s)/Grant(s): RTOP 538-14-12-01

Report No.(s): NASA/TM-2000-210079; NAS 1.15:210079; L-17774; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Results from three wind tunnel tests in the National Transonic Facility of a model of an advanced-technology, subsonic-transport wing-body configuration have been analyzed to assess the test-to-test repeatability of several aerodynamic parameters. The scatter, as measured by the prediction interval, in the longitudinal force and moment coefficients increases as the Mach number increases. Residual errors with and without the ESP tubes installed suggest a bias leading to lower drag with the tubes installed. Residual errors as well as average values of the longitudinal force and moment coefficients show that there are small bias errors between the different tests.

Author

Subsonic Speed; Wind Tunnel Tests; Transonic Wind Tunnels; Body-Wing Configurations

20000032920 NASA Lewis Research Center, Cleveland, OH USA

Correlation Between Geometric Similarity of Ice Shapes and the Resulting Aerodynamic Performance Degradation: A Preliminary Investigation Using WIND

Wright, William B., DYNACS Engineering Co., Inc., USA; Chung, James, NASA Lewis Research Center, USA; December 1999; 30p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): NAS3-98008; RTOP 548-20-23

Report No.(s): NASA/CR-1999-209417; NAS 1.26:209417; E-12057; AIAA Paper 2000-0097; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

Aerodynamic performance calculations were performed using WIND on ten experimental ice shapes and the corresponding ten ice shapes predicted by LEWICE 2.0. The resulting data for lift coefficient and drag coefficient are presented. The difference in aerodynamic results between the experimental ice shapes and the LEWICE ice shapes were compared to the quantitative difference in ice shape geometry presented in an earlier report. Correlations were generated to determine the geometric features which have the most effect on performance degradation. Results show that maximum lift and stall angle can be correlated to the upper horn angle and the leading edge minimum thickness. Drag coefficient can be correlated to the upper horn angle and the frequency-weighted average of the Fourier coefficients. Pitching moment correlated with the upper horn angle and to a much lesser extent to the upper and lower horn thicknesses.

Author

Ice; Ice Formation; Shapes; Thickness; Performance Prediction; Computer Programs; Software Engineering

20000033134 NASA Ames Research Center, Moffett Field, CA USA

Putting the Aero Back into Aeroelasticity

Bousman, William G., Army Aviation and Missile Command, USA; March 2000; 24p; In English; Aeroelasticity of Rotorcraft Systems, 18-20 Oct. 1999, University Park, PA, USA

Contract(s)/Grant(s): RTOP 505-59-87

Report No.(s): NASA/TM-2000-209589; NAS 1.15:209589; A-00V0012; USAAMCOM-TR-00-A-005; AFDD/TR-00-A-005; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The lack of progress in understanding the physics of rotorcraft loads and vibration over the last 30 years is addressed in this paper. As befits this extraordinarily difficult problem, the reasons for the lack of progress are complicated and difficult to ascertain. It is proposed here that the difficulty lies within at least three areas: 1) a loss of perspective as to what are the key factors in rotor loads and vibration, 2) the overlooking of serious unsolved problems in the field, and 3) cultural barriers that impede progress. Some criteria are suggested for future research to provide a more concentrated focus on the problem.

Author

Aeroelasticity; Rotary Wing Aircraft; Vibratory Loads; Aerodynamic Loads

20000033218 NASA Langley Research Center, Hampton, VA USA

A Reynolds Number Study of Wing Leading-Edge Effects on a Supersonic Transport Model at Mach 0.3

Williams, M. Susan, NASA Langley Research Center, USA; Owens, Lewis R., Jr., NASA Langley Research Center, USA; Chu, Julio, NASA Langley Research Center, USA; December 1999; 110p; In English

Contract(s)/Grant(s): RTOP 537-03-22-06

Report No.(s): NASA/TP-1999-209695; NAS 1.60:209695; L-17281; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

A representative supersonic transport design was tested in the National Transonic Facility (NTF) in its original configuration with small-radius leading-edge flaps and also with modified large-radius inboard leading-edge flaps. Aerodynamic data were obtained over a range of Reynolds numbers at a Mach number of 0.3 and angles of attack up to 16 deg. Increasing the radius of the inboard leading-edge flap delayed nose-up pitching moment to a higher lift coefficient. Deflecting the large-radius leading-edge flap produced an overall decrease in lift coefficient and delayed nose-up pitching moment to even higher angles of attack as compared with the undeflected large-radius leading-edge flap. At angles of attack corresponding to the maximum untrimmed lift-to-drag ratio, lift and drag coefficients decreased while lift-to-drag ratio increased with increasing Reynolds number. At an angle of attack of 13.5 deg., the pitching-moment coefficient was nearly constant with increasing Reynolds number for both the small-radius leading-edge flap and the deflected large-radius leading-edge flap. However, the pitching moment

coefficient increased with increasing Reynolds number for the undeflected large-radius leading-edge flap above a chord Reynolds number of about 35×10^6 (exp 6).

Author

Leading Edge Flaps; Reynolds Number; Supersonic Transports; Transonic Wind Tunnels; Mach Number; Wings; Aerodynamic Coefficients

20000033256 NASA Langley Research Center, Hampton, VA USA

Contributions of the NASA Langley Transonic Dynamics Tunnel to Launch Vehicle and Spacecraft Development

Cole, Stanley R., NASA Langley Research Center, USA; Keller, Donald F., NASA Langley Research Center, USA; Piatak, David J., NASA Langley Research Center, USA; [2000]; 62p; In English; Dynamics Specialists Conference, 5-6 Apr. 2000, Atlanta, GA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2000-1772; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The NASA Langley Transonic Dynamics Tunnel (TDT) has provided wind-tunnel experimental validation and research data for numerous launch vehicles and spacecraft throughout its forty year history. Most of these tests have dealt with some aspect of aeroelastic or unsteady-response testing, which is the primary purpose of the TDT facility. However, some space-related test programs that have not involved aeroelasticity have used the TDT to take advantage of specific characteristics of the wind-tunnel facility. In general, the heavy gas test medium, variable pressure, relatively high Reynolds number and large size of the TDT test section have made it the preferred facility for these tests. The space-related tests conducted in the TDT have been divided into five categories. These categories are ground wind loads, launch vehicle dynamics, atmospheric flight of space vehicles, atmospheric reentry, and planetary-probe testing. All known TDT tests of launch vehicles and spacecraft are discussed in this report. An attempt has been made to succinctly summarize each wind-tunnel test, or in the case of multiple, related tests, each wind-tunnel program. Most summaries include model program discussion, description of the physical wind-tunnel model, and some typical or significant test results. When available, references are presented to assist the reader in further pursuing information on the tests.

Author

Wind Tunnel Tests; Transonic Wind Tunnels; Launch Vehicles; Ground Wind; Gas Pressure; Dynamic Response

03

AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; aircraft ground operations; flight safety and hazards; and aircraft accidents. Systems and hardware specific to ground operations of aircraft and to airport construction are covered in 09 Research and Support Facilities (Air). Air traffic control is covered in 04 Aircraft Communications and Navigation.

20000027417 Lockheed Martin Aeronautical Systems, Marietta, GA USA

Lockheed Martin C-130J Natural Icing FAA Certification Program

Johnston, R. L., Lockheed Martin Aeronautical Systems, USA; Ryan, R. J., Lockheed Martin Aeronautical Systems, USA; 1999 Report to the Aerospace Profession: Forty Third Symposium Proceedings; September 1999, pp. 33-57; In English; See also 20000027414; Copyright; Avail: Issuing Activity

The C-130J is the modern variant of the legendary C-130 military transport. The changes incorporated in the "J" are the most dramatic of any version since the original was introduced in 1954. Through the application of mature technologies, new high performance engines, composite propellers, and a glass cockpit with computer controlled automation, virtually every system and aspect of the basic C-130 aircraft has undergone change. The ice protection system was no exception. It was redesigned to provide increased capability, and many lessons were learned during the comprehensive two-year icing certification program that culminated in Federal Aircraft Administration (FAA) Type Certification on 9 September 1998. The program included dry air testing for thermodynamic modeling icing tanker spray testing for validating subsystem performance, extensive simulated ice shape testing to verify adequate flying qualities, and natural ice testing to validate the design. Increased FAA attention to icing certification required more extensive testing and scrutiny than previous C-130 certification efforts. An atmosphere of compressed certification schedules and unexpected early test results created both design and testing challenges. These included design and fabrication of an icing tanker to replace the retired USAF KC-135A aircraft and a substantial redesign of the vertical tail ice protection system. When system redesign forced test performance into the summer months, the test team was compelled to relocate to Argentina in the Southern Hemisphere to find natural icing conditions and successfully complete critical program milestones. The 'pristine' southern Argentina atmosphere provided numerous icing events, including several encounters with large areas of supercooled large droplets (SLD).

Since FAA certification does not currently require aircraft protection from SLD conditions, the test results are being considered by the FAA as input for changing the icing certification requirements for transport aircraft.

Author

C-130 Aircraft; Ice; Aircraft Icing; Ice Prevention; Flight Conditions; Deicing; Certification

20000027422 National Test Pilot School, Mojave, CA USA

Flight Test Safety in Civil Certification

Lewis, Gregory V., National Test Pilot School, USA; 1999 Report to the Aerospace Profession: Forty Third Symposium Proceedings; September 1999, pp. 112-118; In English; See also 20000027414; Copyright; Avail: Issuing Activity

The objective of this paper is to identify flight test hazards that are unique to the certification of new or modified aircraft. The paper then explains how the FAA and the National Test Pilot School (NTPS) are working together to reduce the impact of those hazards as well as the traditional hazards of flight testing. It should be noted at the outset that flight safety cannot be the primary goal in any program. All flying, including routine flying of fully certified aircraft, involves danger. If the most important goal is safety, then that can best be achieved by not flying at all. So the key is to achieve our technical goals while reducing the risks to an acceptable level.

Derived from text

Flight Tests; Flight Safety; Certification; Civil Aviation

20000027423 Air Line Pilots Association, Elmhurst, NY USA

Flight Test Results of the Controlled Flight Into Terrain Avoidance Maneuver in Fly-By-Wire Transports

Rogers, Ron, Air Line Pilots Association, USA; Stowe, Steve, Air Line Pilots Association, USA; Lutz, Terry, Air Line Pilots Association, USA; Kohler, Joe, Air Line Pilots Association, USA; 1999 Report to the Aerospace Profession: Forty Third Symposium Proceedings; September 1999, pp. 119-130; In English; See also 20000027414; Copyright; Avail: Issuing Activity

Controlled Flight into Terrain (CFIT) is the leading causes of aviation accidents. A test program was developed to compare the CFIT maneuver performance capabilities of Fly-By-Wire (FBW) aircraft with hard versus soft flight control limits, to obtain this data, simulated CFIT avoidance maneuvers utilizing a Boeing 777-300 and an Airbus A330-200 were performed. These tests were performed at the Boeing Flight Test Facility in Seattle, Washington and the Airbus Flight Test Facility at Toulouse, France. This flight test had a two-fold purpose. The first was to evaluate the effectiveness and appropriateness of a recovery technique that was developed for convention aircraft without regard for the flight envelope protections incorporated in modern FBW aircraft. The second purpose was to develop and/or evaluate CFIT escape maneuvers that utilize the maximum capability of the aircraft afforded by the protections incorporated in their respective FBW flight control systems. As a direct result of this flight test activity, United Airlines and Northwest Airlines have changed their CFIT escape maneuver for Airbus aircraft. US Airways, a new Airbus operator, adopted our recommendations from the onset.

Author

Fly by Wire Control; Aircraft Control; Terrain; Flight Tests; Flight Envelopes; Aircraft Maneuvers; Aircraft Performance

20000027424 Department of the Air Force, 412th Operations Group, Edwards AFB, CA USA

The A.R.T. of Ground Collision Avoidance System Testing

Wilson, Robert A., Department of the Air Force, USA; Seelos, Michael, Department of the Air Force, USA; 1999 Report to the Aerospace Profession: Forty Third Symposium Proceedings; September 1999, pp. 131-144; In English; See also 20000027414; Copyright; Avail: Issuing Activity

This paper discusses considerations developed by the Air Force Flight Test Center test system safety process for assessing the risk associated with testing ground collision avoidance systems (GCAS). It specifically discusses available reaction time (A.R.T.) as a tool used to assess the risk of test points flown by the F-16 Combined Test Force at Edwards Air Force Base, California, during Digital Terrain System (DTS) developmental test and evaluation. The A.R.T. system uses time to ground impact as a normalizing factor to define the risk associated with flying any given GCAS test point. The numerous risk factors associated with GCAS testing and the necessary assumptions required to conduct such testing safely are also discussed. The initial results of the DTS testing that affected the A.R.T. based risk assessment are presented along with how the risk assessment was changed based on the lessons learned about pilot reaction times and pilot comfort level. Overall, the paper emphasizes basic principles that apply to conducting GCAS testing in any type of aircraft from fighters to transports.

Author

Reaction Time; Test Pilots; Ground Tests; Flight Tests; Collision Avoidance; Flight Safety; Safety Factors

20000027697 National Science and Technology Council, Subcommittee on Transportation Research and Development, Washington, DC USA

National Research Agenda for Transportation and Sustainable Communities

Sep. 1999; 28p; In English

Report No.(s): PB2000-102554; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

This Plan, prepared by DOT for the NSTC Committee on Technology, serves as a benchmark for the future interagency cooperative efforts to optimize essential government research toward the attainment of critical aviation and air transportation goals. This report represents a broad new consensus among FAA, NASA, and DOD as to aviation goals agency roles in R&D to support civil aviation, and provides the foundation for developing more-integrated program plans in the future. This document provides an overview of the full spectrum of aviation research in the context of long-term objectives and programmatic structures. It is an important element in implementing the formal R&D partnership established between FAA and NASA in October 1998.

NTIS

Air Transportation; Research and Development

20000028399 Cherry (R. G. W.) and Associates Ltd., Hertford, UK

A Benefit Analysis for Nitrogen Inerting of Aircraft Fuel Tanks Against Ground Fire Explosion *Final Report*

Cherry, Ray; Warren, Kevin; Dec. 1999; 117p; In English

Report No.(s): AD-A373137; DOT/FAA/AR-99/73; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The International Cabin Safety Research Technical Group's Survivable Accidents Database was used to identify past worldwide transport aircraft accidents and extract detailed data for those accidents where explosion was an issue in the survivability of the occupants. Each of these accidents was analysed in depth to assess the number of lives and injuries that might be saved if the fuel tanks were protected with nitrogen inerting systems. The objective of this analysis was to assess the potential benefits, in terms of reducing fatalities and injuries, resulting from three methods of aircraft fuel tank inerting. The methods analyzed were ground nitrogen inerting in centre fuel tank only, ground nitrogen inerting in all fuel tanks, and onboard nitrogen inerting in all fuel tanks. Thirteen accidents to transport category aircraft were identified during the period from 1966 to 1995 that may have involved a fuel tank explosion. A mathematical technique was used to model each accident scenario and a Monte Carlo simulation was used to assess a high, median, and low value for the total achievable benefits.

DTIC

Nitrogen; Aircraft Fuels; Fuel Tanks; Fires; Propellant Explosions

20000029583 NASA Langley Research Center, Hampton, VA USA

The Flight Deck Perspective of the NASA Langley AILS Concept

Rine, Laura L., NASA Langley Research Center, USA; Abbott, Terence S., NASA Langley Research Center, USA; Lohr, Gary W., NASA Langley Research Center, USA; Elliott, Dawn M., NASA Langley Research Center, USA; Waller, Marvin C., NASA Langley Research Center, USA; Perry, R. Brad, NASA Langley Research Center, USA; January 2000; 52p; In English

Contract(s)/Grant(s): RTOP 576-02-11-17

Report No.(s): NASA/TM-2000-209841; L-17820; NAS 1.15:209841; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Many US airports depend on parallel runway operations to meet the growing demand for day to day operations. In the current airspace system, Instrument Meteorological Conditions (IMC) reduce the capacity of close parallel runway operations; that is, runways spaced closer than 4300 ft. These capacity losses can result in landing delays causing inconveniences to the traveling public, interruptions in commerce, and increased operating costs to the airlines. This document presents the flight deck perspective component of the Airborne Information for Lateral Spacing (AILS) approaches to close parallel runways in IMC. It represents the ideas the NASA Langley Research Center (LaRC) AILS Development Team envisions to integrate a number of components and procedures into a workable system for conducting close parallel runway approaches. An initial documentation of the aspects of this concept was sponsored by LaRC and completed in 1996. Since that time a number of the aspects have evolved to a more mature state. This paper is an update of the earlier documentation.

Derived from text

Airline Operations; Runways; Airborne Equipment; Aircraft Approach Spacing; Air Navigation

20000031353 National Center for Atmospheric Research, Boulder, CO USA

Results of Holdover Time Testing of Type 4 Anti-Icing Fluids With the Improved NCAR Artificial Snow Generation System *Final Report*

Rasmussen, Roy M.; Hills, Allan; Landolt, Scott; Knight, Charlie; Dec. 1999; 44p; In English

Report No.(s): AD-A372713; DOT/FAA/AR-99/10; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report discusses improvements to the National Center for Atmospheric Research (NCAR) artificial snow generation machine and the results of anti-icing fluid testing with the improved machine. The improvements include: (1) improved control of snowfall rate, (2) development of an integrated frosticator plate/snow mass measuring system, (3) automatic control and recording of the experiment, and (4) direct control of the frosticator plate temperature through an area heater controlled by an interface unit. This improved machine was used to conduct anti-icing fluid holdover time tests on several Type IV fluids. The results showed the typical inverse relationship between holdover time and snowfall rate. The results from the improved machine were compared to previous natural and artificial snow tests conducted by the University of Quebec at Chicoutimi and NCAR and showed good agreement in general. Tests with varying snowfall rates showed a factor of 1.5 to 2.0 longer holdover time for nonconstant snowfall rates. This result suggests that natural snow conditions are not as severe as the constant snowfall rate conditions tested in the laboratory. Causes for the longer holdover time were suggested to be: (1) the longer time available for the absorption of the melted snow water, and (2) the warmer temperatures experienced during the time varying rate tests as compared to the constant rate tests.

DTIC

Automatic Control; Deicers; Ice Prevention

20000031873 Army Safety Center, Fort Rucker, AL USA

FLIGHTFAX: Army Aviation Risk-Management Information. Volume 28, Number 1

Jan. 2000; 12p; In English

Report No.(s): AD-A373329; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Many aviators have their own ideas about how to mitigate the risks associated with blowing snow. As part of the winter academic program, it may be useful to survey aircrews to determine which hazards they consider the most severe, and evaluate the effectiveness of the controls that are in place. From such a survey, necessary upgrades to winter training plans and development of new controls can be put in place. Winter has been a regular on the calendar for a long, long time. There's nothing we can do about that, even if we wanted to. In fact, the very predictability of changing seasons gives us time to plan our training for the different kinds of flying problems each season brings. If you haven't already done it, get your refresher training, review FM 1-202, and be alert to the hazards associated with winter flying.

DTIC

Flight Crews; Aircraft Safety; Aircraft Accidents; Aircraft Pilots

20000031967 Federal Aviation Administration, Technical Center, Atlantic City, NJ USA

Application of the FAATC Risk Management Process to the Airport Vulnerability Assessment and Analysis Project (AVAP) Final Report

Lazarick, R. T., Federal Aviation Administration, USA; Jun. 1999; 26p; In English

Contract(s)/Grant(s): DT059-96-D-00410

Report No.(s): PB2000-101748; DOT/FAA/AR-99/95; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

This report summarizes Abacus Technology Corporation's experience in conducting risk/vulnerability assessments of airports in support of the Federal Aviation Administration (FAA) Airport Vulnerability Assessment and Analysis Project (AVAP). The report describes Abacus Technology's findings regarding application and effectiveness of the Risk Management Process developed for the FAATC and of the selected automated tool methodologies.

NTIS

Airport Security; Threat Evaluation

20000031968 Federal Aviation Administration, Technical Center, Atlantic City, NJ USA

Guide to the FAATC Risk Management Process Final Report

Lazarick, R. T., Federal Aviation Administration, USA; Jun. 1999; 90p; In English

Contract(s)/Grant(s): DT059-96-D-00410

Report No.(s): PB2000-101747; DOT/FAA/AR-99/94; No Copyright; Avail: CASI; A01, Microfiche; A05, Hardcopy

This report provides a summary and guidance to the Federal Aviation Administration (FAA) William J. Hughes Technical Center (FAATC) Risk Management Process, developed by Abacus Technology Corporation in conjunction with the FAATC. Abacus Technology used the Risk Management Process in conducting risk/vulnerability assessments of airports in support of the FAA Airport Vulnerability Assessment and Analysis Project (AVAP). The report includes a discussion of risk management

concepts; a summary of the process modeling approach used to diagram the process steps; a description of the process; a complete diagram of the process; and a glossary of terms and concepts.

NTIS

Airport Security; Automation; Management Planning

20000032388 Research and Technology Organization, Human Factors and Medicine Panel, Neuilly-sur-Seine, France
Models for Aircrew Safety Assessment: Uses, Limitations and Requirements *La Modelisation des Conditions de Securite des Equipages: Applications, Limitations et Cahiers des Charges*

August 1999; 360p; In English, 26-28 Oct. 1998, Wright AFB, OH, USA; See also 20000032389 through 20000032420; Original contains color illustrations

Report No.(s): RTO-MP-20; AC/323(HFM)TP/7; ISBN 92-837-1017-7; Copyright Waived; Avail: CASI; A16, Hardcopy; A03, Microfiche

These proceedings include the Technical Evaluation Report, a tribute to Dr. Henning E. von Gierke, Director Emeritus, Wright-Patterson Air Force Base (WPAFB), OH, three Keynote Addresses and 32 invited papers of a Specialists' Meeting sponsored by the NATO/RTO Human Factors and Medicine Panel. It was held at WPAFB from 26-28 October 1998. Significant advances have been made in modelling human physical and physiological responses to extreme environments. Technological advances in computer speed and power have made modelling a feasible research and design tool. Computer simulations are being used extensively for predicting human physical and physiological responses, for reducing testing requirements, for rapidly designing improved protective systems, and for performing human safety-systems analyses. A variety of models were reviewed at this Specialists' Meeting including lumped-parameter, rigid-body, finite-element, statistical, physiologic, and empirical models. Topics covered included modelling human-body responses to environmental stressors, and the systems with which the body interacts to impact, emergency escape, sustained acceleration, vibration, mechanical shock, motion sickness, high altitude, blast, extreme thermal conditions, directed energy, and live firing. These proceedings will be of interest to military and civilian scientists and engineers interested in exploiting data bases, tolerance criteria, and new models and methods in the research of physiological systems and in simulating the design, test set up and evaluation of safety systems.

Author

Computerized Simulation; Conferences; Human Factors Engineering; Mathematical Models; Flight Crews; Safety Factors; Human Body; Physiological Responses

20000032400 Missouri Univ., Dept. of Mechanical and Aerospace Engineering and Engineering Mechanics, Rolla, MO USA
Forces and Deformed Configurations of an Airbag During Inflation and Impact

Avula, Xavier J. R., Missouri Univ., USA; Kaleps, Ints, Air Force Research Lab., USA; Mysore, Prasad, Missouri Univ., USA; Models for Aircrew Safety Assessment: Uses, Limitations and Requirements; August 1999, pp. 12-1 - 12-14; In English; See also 20000032388

Contract(s)/Grant(s): F41624-95-C-6014; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

In this work, the evolution of forces and deformed configurations of an airbag during inflation and impact with a rigid sphere were investigated for various airbag parameters. The parameters considered were fabric density, bag elasticity, input gas temperature and vent size. The computations were performed using a non-linear finite element method coded in the LS-DYNA3D package. The influence of the above mentioned parameters on the contact during the impact was significant: lowering the fabric density resulted in higher bag velocity which in turn resulted in higher rebound velocity of an impacting sphere; fabrics of lower elasticity had shown increased contact time and higher rebound velocity; the lower the input gas temperature, the longer was the contact time and the lower the rebound velocity of the sphere. The acceleration and rebound velocity had an inverse relationship with vent area. These observations with additional studies could be used in the development of better occupant safety systems.

Author

Air Bag Restraint Devices; Finite Element Method; Human Factors Engineering; Deformation; Loads (Forces); Inflatable Structures; Impact Damage

20000032466 Hynes and Associates, Inc., Frederick, OK USA

Evacuee Injuries and Demographics in Transport Airplane Precautionary Emergency Evacuations

Hynes, Michael K., Hynes and Associates, Inc., USA; March 2000; 22p; In English

Contract(s)/Grant(s): DTFA96-P-51602; DTFA02-99-VO5793; AM-B-97-PRS-93

Report No.(s): DOT/FAA/AM-00/11; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

During a nine-year period from January 1, 1988, through December 31, 1996, there were more than 500 transport airplane precautionary emergency evacuations (PEEvacs), occurring on average about once a week. Each year as many as 6,000 persons

participated in these events. In many cases, passenger and crewmember injuries resulted from the PEEvacs, resulting in large personal costs to passengers and crewmembers, as well as financial costs estimated to be in excess of \$1 1 million annually to airlines. This study was undertaken to sample available evacuee and injury data related to a subset of those PEEvacs, including information on types and causes of evacuee injuries, and evacuee age and gender. Other demographics were sought, but that information was generally unavailable. Unique, direct contacts with airport management were used to supplement publicly available information on certain of the PEEvacs, including activation of emergency escape slides during PEEvacs, injuries caused by the PEEvacs, and outcomes. of the 136 airports identified as experiencing PEEvacs, 24 were selected to provide detailed data on injured evacuees for a 34-month interval lasting from December 1994 through November 1996. During this time frame, there were 109 precautionary evacuations at the 24 airports selected, i.e., approximately 70% of all reported evacuation events that occurred during the study period. Specific information on 193 persons injured during 19 of these evacuations was obtained and analyzed. The results of this study confirm the need for improved incident reporting and continued research into preventing injuries associated with the use of emergency egress systems and precautionary emergency evacuations of transport airplanes. The results should be additionally useful when considering proposed changes to applicable regulations and to airline training programs and aircraft emergency operations.

Author

Transport Aircraft; Flight Operations; Emergencies; Injuries; Airline Operations; Crews

20000032489 National Transportation Safety Board, Washington, DC USA

National Transportation Safety Board Safety Recommendations Adopted during the Month of December, 1999

Dec. 1999; 20p; In English

Report No.(s): PB99-916612; NTSB/REC-99/12; No Copyright; Avail: National Technical Information Service (NTIS)

This publication contains safety recommendations in aviation mode (only) of transportation adopted by the National Transportation Safety Board during the month of December, 1999.

NTIS

Safety Management; Air Transportation

20000032865 Textron Bell Helicopter, Fort Worth, TX USA

Application of Damage Tolerance to Increase Safety of Helicopters in Service

Krasnowski, Bogdan R., Textron Bell Helicopter, USA; Application of Damage Tolerance Principles for Improved Airworthiness of Rotorcraft; February 2000, pp. 7 - 1 - 7 - 8; In English; See also 20000032859; Copyright Waived; Avail: CASI; A02, Hardcopy

In the past, all helicopters have been designed to safe-life requirements. Introduced in October 1989, FAR 29.571 at Amendment 28 requires damage tolerance substantiation for transport category helicopters. Therefore, the majority of helicopters currently in service were designed to safe-life requirements. In general, the safe-life approach has proven to be adequate. However, there have been a number of field problems with cracking components, which lend themselves to the application of a damage tolerance approach. Damage tolerance analysis allows addressing the safety of the cracking components by: Evaluation of the field cracking, supported by the laboratory evaluation of the field-returned cracks; Establishment of the inspection interval in conjunction, if necessary, with operation limitations; and Specification of fixes to be applied to the structure to either increase the inspection limit and/or lift the operation limitations. to accomplish the above listed tasks, crack growth analysis is performed using the appropriate usage spectrum and the flight load survey data. If necessary, usage spectrum reviews and additional flight load surveys could be required. The crack growth analysis results are verified by the laboratory evaluation of the cracked components, and if necessary by the additional crack growth testing of the field-returned components with cracks or the pre-cracked components.

Author

Crack Propagation; Tolerances (Mechanics); Damage; Helicopters; Cracks; Aircraft Safety; Helicopter Design

20000032866 Agusta A. Finmeccanica Co., Cascina Costa di Samarate, Italy

AGUSTA Experience on Damage Tolerance Evaluation of Helicopter Components

Mariani, Ugo, Agusta A. Finmeccanica Co., Italy; Candiani, Luigi, Agusta A. Finmeccanica Co., Italy; Application of Damage Tolerance Principles for Improved Airworthiness of Rotorcraft; February 2000, pp. 8 - 1 - 8 - 12; In English; See also 20000032859; Copyright Waived; Avail: CASI; A03, Hardcopy

Within the fatigue evaluation of the EHL01, Agusta has carried out a specific program of flaw tolerance evaluation of the primary loading path. The program is close to completion and this paper provides a summary of the most relevant results. For composite components, damage size was increased considering both manufacturing discrepancies greater than the minimum quality standard and impact damages clearly detectable during visual inspections. The favourable data achieved are based on the

"no growth" concept. The metal parts of the main rotor head were evaluated by enhanced safe life method and fail safe capability. The slow crack growth approach was instead applied for the Rear Fuselage End Fittings, which connect the Tail Unit. All these evidences can be used in addition to the comprehensive safe life evaluation of the aircraft to improve the maintenance and the repair actions. Based on this experience, application of flaw tolerance criteria will be carried out on the new helicopters in development phase.

Author

Eh-101 Helicopter; Composite Materials; Crack Propagation; Impact Damage; Tolerances (Mechanics); Helicopters; Aircraft Structures; Fiber Composites

20000032979 NASA Ames Research Center, Moffett Field, CA USA

Transition to Glass: Pilot Training for High-Technology Transport Aircraft

Wiener, Earl L., Miami Univ., USA; Chute, Rebecca D., Raytheon ITSS Corp., USA; Moses, John H., Miami Univ., USA; May 1999; 254p; In English

Contract(s)/Grant(s): RTOP 548-40-12

Report No.(s): NASA/CR-1999-208784; NAS 1.26:208784; A-990105; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

This report examines the activities of a major commercial air carrier between 1993 and late 1996 as it acquired an advanced fleet of high-technology aircraft (Boeing 757). Previously, the airline's fleet consisted of traditional (non-glass) aircraft, and this report examines the transition from a traditional fleet to a glass one. A total of 150 pilots who were entering the B-757 transition training volunteered for the study, which consisted of three query phases: (1) first day of transition training, (2) 3 to 4 months after transition training, and (3) 12 to 14 months after initial operating experience. Of these initial 150 pilots, 99 completed all three phases of the study, with each phase consisting of probes on attitudes and experiences associated with their training and eventual transition to flying the line. In addition to the three questionnaires, 20 in-depth interviews were conducted. Although the primary focus of this study was on the flight training program, additional factors such as technical support, documentation, and training aids were investigated as well. The findings generally indicate that the pilot volunteers were highly motivated and very enthusiastic about their training program. In addition, the group had low levels of apprehension toward automation and expressed a high degree of satisfaction toward their training. However, there were some concerns expressed regarding the deficiencies in some of the training aids and lack of a free-play flight management system training device.

Author

Education; Glass; Pilot Training; Transport Aircraft; Cockpits; Human Factors Engineering

20000033133 NASA Ames Research Center, Moffett Field, CA USA

A Comparison of Center/TRACON Automation System and Airline Time of Arrival Predictions

Heere, Karen R., Raytheon Co., USA; Zelenka, Richard E., NASA Ames Research Center, USA; February 2000; 26p; In English

Contract(s)/Grant(s): RTOP 727-01-24

Report No.(s): NASA/TM-2000-209584; NAS 1.15:209584; A-00V0006; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Benefits from information sharing between an air traffic service provider and a major air carrier are evaluated. Aircraft arrival time schedules generated by the NASA/FAA Center/TRACON Automation System (CTAS) were provided to the American Airlines System Operations Control Center in Fort Worth, Texas, during a field trial of a specialized CTAS display. A statistical analysis indicates that the CTAS schedules, based on aircraft trajectories predicted from real-time radar and weather data, are substantially more accurate than the traditional airline arrival time estimates, constructed from flight plans and en route crew updates. The improvement offered by CTAS is especially advantageous during periods of heavy traffic and substantial terminal area delay, allowing the airline to avoid large predictive errors with serious impact on the efficiency and profitability of flight operations.

Author

Automatic Control; Flight Operations; Airline Operations

20000033363 NASA Langley Research Center, Hampton, VA USA

Flow Environment Study Near the Empennage of a 15-Percent Scale Helicopter Model

Gorton, Susan Althoff, NASA Langley Research Center, USA; Berry, John D., Army Aviation and Missile Command, USA; Hodges, W. Todd, Army Aviation and Missile Command, USA; Reis, Deane G., Army Aviation and Missile Command, USA; March 2000; 30p; In English; Original contains color illustrations

Contract(s)/Grant(s): RTOP 581-10-11-01

Report No.(s): NASA/TP-2000-210085; L-17940; NAS 1.60:210085; AFDD/TR-00-A-004; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Development of advanced rotorcraft configurations has highlighted a need for high-quality experimental data to support the development of flexible and accurate analytical design tools. To provide this type of data, a test program was conducted in the Langley 14- by 22-Foot Subsonic Tunnel to measure the flow near the empennage of a 15-percent scale powered helicopter model with an operating tail fan. Three-component velocity profiles were measured with laser velocimetry (LV) one chord forward of the horizontal tail for four advance ratios to evaluate the effect of the rotor wake impingement on the horizontal tail angle of attack. These velocity data indicate the horizontal tail can experience unsteady angle of attack variations of over 30 degrees due to the rotor wake influence. The horizontal tail is most affected by the rotor wake above advance ratios of 0.10. Velocity measurements of the flow on the inlet side of the tail fan were made for a low-speed flight condition using conventional LV techniques. The velocity data show an accelerated flow near the tail fan duct, and vorticity calculations track the passage of main rotor wake vortices through the measurement plane.

Author

Helicopters; Design Analysis; Horizontal Tail Surfaces; Rotary Wing Aircraft; Scale Models; Angle of Attack

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes all modes of communication with and between aircraft; air navigation systems (satellite and ground based); and air traffic control.

20000031391 Pennsylvania State Univ., Dept. of Computer Science and Engineering, University Park, PA USA

Obstacle Detection Algorithms for Aircraft Navigation: Performance Characterization of Obstacle Detection Algorithms for Aircraft Navigation Final Report, 1 Aug. 1997 - 31 Dec. 1999

Kasturi, Rangachar, Pennsylvania State Univ., USA; Camps, Octavia, Pennsylvania State Univ., USA; Coraor, Lee, Pennsylvania State Univ., USA; Jan. 28, 2000; 221p; In English

Contract(s)/Grant(s): NAG2-1152

Report No.(s): TR-CSE-00-002; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

The research reported here is a part of NASA's Synthetic Vision System (SVS) project for the development of a High Speed Civil Transport Aircraft (HSCT). One of the components of the SVS is a module for detection of potential obstacles in the aircraft's flight path by analyzing the images captured by an on-board camera in real-time. Design of such a module includes the selection and characterization of robust, reliable, and fast techniques and their implementation for execution in real-time. This report describes the results of our research in realizing such a design. It is organized into three parts. Part I. Data modeling and camera characterization; Part II. Algorithms for detecting airborne obstacles; and Part III. Real time implementation of obstacle detection algorithms on the Datacube MaxPCI architecture. A list of publications resulting from this grant as well as a list of relevant publications resulting from prior NASA grants on this topic are presented.

Derived from text

Algorithms; Obstacle Avoidance; Air Navigation; Aircraft Performance; Supersonic Transports; Detection

20000031604 Department of the Navy, Washington, DC USA

Air-Delivered Position Marking Device and Method

Woodall, Robert C., Jr, Inventor; Sep. 14, 1999; 9p; In English

Patent Info.: Filed 8 Dec. 97.; US-Patent-Appl-SN-08,986,983; US-Patent-5,951,346

Report No.(s): AD-D019576; No Copyright; Avail: US Patent and Trademark Office, Microfiche

An air-deliverable global positioning system (GPS) position marking device and method involves the operations of providing an air-deliverable GPS position marking device, launching the device into flight through the air to a desired location, arming the device in response to launching the device into flight, firing a detonation mechanism contained in the device when the device is at the desired location after receipt of a magneto-inductive transmission so as to generate a predetermined pressure in an interior chamber of the device that causes ejection of a payload assembly from the interior chamber, initiates inflation of an inflatable flotation body of the payload assembly, and initiates communications between a GPS receiver and transmitter unit in the payload assembly and a remote station to determine the position of the position marking device at the desired location.

DTIC

Airdrops; Global Positioning System; Position (Location); Tracking (Position); Patents

20000031643 Air Force Research Lab., Human Effectiveness Directorate, Wright-Patterson AFB, OH USA
Flying Complex Approaches Using a Head-Up Display: Effects of Visibility and Display Type *Final Report*
Snow, Michael P.; Reising, John M.; Liggett, Kristen K.; Barry, Timothy P.; Apr. 1999; 9p; In English; Prepared in collaboration with North Coast Simulations, Dayton, OH.

Contract(s)/Grant(s): Proj-2403

Report No.(s): AD-A373468; AFRL-HE-WP-TR-2000-0011; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Air traffic controllers will soon have the ability to direct pilots to fly complex landing approaches. The imminent replacement of the Instrument landing System (ILS) with a landing system based on Global Positioning System (GPS) technology at major airports in the USA will allow pilots to fly landing approaches with curved segment and varying descent rates. From a military standpoint, flying complex approaches will allow better threat avoidance and operational security. Current head up primary flight references may be inadequate to fly these complex approaches, but the proposed alternative a pathway in the sky and/or synthetic terrain display may involve too much clutter for a head up display (HUD), depending on visibility conditions. This paper reports findings research in the Air Force Research Laboratory designed to create a next generation, head up primary flight reference that will allow pilots to fly complex approach and weapon delivery paths regardless of visibility conditions. The conclusions reported herein are that a head up pathway in the sky display will greatly improve pilots' ability to fly complex flight paths in comparison to the current military standard head up display regardless of external visibility. Synthetic terrain in the HUD will improve situation awareness in reduced visibility conditions.

DTIC

Instrument Landing Systems; Flight Paths; Landing Aids; Head-Up Displays; Air Navigation

20000031724 NASA Goddard Space Flight Center, Greenbelt, MD USA

Enabling Spacecraft Formation Flying in Any Earth Orbit Through Spaceborne GPS and Enhanced Autonomy Technologies

Bauer, F. H., NASA Goddard Space Flight Center, USA; Bristow, J. O., NASA Goddard Space Flight Center, USA; Carpenter, J. R., NASA Goddard Space Flight Center, USA; Garrison, J. L., NASA Goddard Space Flight Center, USA; Hartman, K. R., NASA Goddard Space Flight Center, USA; Lee, T., Computer Sciences Corp., USA; Long, A. C., Computer Sciences Corp., USA; Kelbel, D., Computer Sciences Corp., USA; Lu, V., Computer Sciences Corp., USA; How, J. P., Stanford Univ., USA; Busse, F., Stanford Univ., USA; Dec. 14, 2000; 35p; In English; GPS Workshop, Feb. 2000, Breckenridge, CO, USA; Sponsored by European Space Agency, International Organization

Contract(s)/Grant(s): RTOP 572-315-80-21-78; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Formation flying is quickly revolutionizing the way the space community conducts autonomous science missions around the Earth and in space. This technological revolution will provide new, innovative ways for this community to gather scientific information, share this information between space vehicles and the ground, and expedite the human exploration of space. Once fully matured, this technology will result in swarms of space vehicles flying as a virtual platform and gathering significantly more and better science data than is possible today. Formation flying will be enabled through the development and deployment of spaceborne differential Global Positioning System (GPS) technology and through innovative spacecraft autonomy techniques. This paper provides an overview of the current status of NASA/DoD/Industry/University partnership to bring formation flying technology to the forefront as quickly as possible, the hurdles that need to be overcome to achieve the formation flying vision, and the team's approach to transfer this technology to space. It will also describe some of the formation flying testbeds, such as Orion, that are being developed to demonstrate and validate these innovative GPS sensing and formation control technologies.

Author

Global Positioning System; Earth Orbits; Autonomy; Spacecraft Launching; Technology Assessment

20000031866 Colorado Univ., Colorado Center for Astrodynamics Research, Boulder, CO USA

Spaceborne Differential GPS Applications *Final Report, 1 Sep. 1997 - 31 Aug. 1999*

Axelrad, Penina; Highsmith, Dolan; Reichert, Angela; Feb. 17, 2000; 71p; In English

Contract(s)/Grant(s): N00014-97-1-G025; Proj-81-0337-97

Report No.(s): AD-A373747; PA-99-305; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

This final technical report summarizes the research performed by the Colorado Center for Astrodynamics Research (CCAR) for the Naval Research Laboratory (NRL) on Spaceborne Differential GPS Applications over the period 01 September 1997 through 31 August 1999. The primary focus of our work was on relative state estimation using GPS data from two vehicles. Data from a spaceborne experiment conducted by NASA was used for algorithm development and performance analysis. An auxiliary area of research was the identification and reduction of multipath errors in GPS observations. This effort is key to full utilization of GPS for high precision applications such as attitude determination, differential GPS, and relative navigation. The report

comprises three documents describing the research. The first two are conference papers presented at ION GPS 99 describing the relative navigation and multipath research. The third is a doctoral dissertation research proposal written by Dolan Highsmith, summarizing his research on this project and plans for future work.

DTIC

Spaceborne Experiments; Global Positioning System; Technology Utilization

20000032020 Communications Research Lab., Tokyo, Japan

Precise Positioning Technique Using GPS, 4, Digital Sampling Data Acquisition Method for "PRESTAR"

Imae, Mitchito, Communications Research Lab., Japan; Kiuchi, Hitoshi, Communications Research Lab., Japan; Kaneko, Akihiro, Communications Research Lab., Japan; Sugimoto, Yuji, Communications Research Lab., Japan; Review of the Communications Research Laboratory; Dec. 1993; ISSN 0914-9279; Volume 39, No. 4, pp. 229-235; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The ionospheric delay variation is one of the largest error sources for the precise space geodesy such as VLBI and GPS. The prototype version of the "PRESTAR" had a problem of the precise measurement of the L2 carrier signal for the precise compensation of the ionospheric delay. To solve this problem, the "digital sampling method" is applied to the prototype version of the "PRESTAR" for the pseudo-range measurement. The experimental results show the digital sampling method successfully works for the precise ionospheric delay compensation. This paper mainly describes the concept and the hardware of the digital sampling method for the phase measurements.

Author

Positioning; Global Positioning System; Sampling; Data Acquisition

20000032021 Communications Research Lab., Tokyo, Japan

Precise Positioning Technique Using GPS, 3, Differential GPS Receiver

Kiuchi, Hitoshi, Communications Research Lab., Japan; Sugimoto, Yuji, Communications Research Lab., Japan; Kameyama, Kiyonobu, Communications Research Lab., Japan; Review of the Communications Research Laboratory; Dec. 1993; ISSN 0914-9279; Volume 39, No. 4, pp. 215-227; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Differential measurement method is never fail to high accuracy geodesy. We discussed about differential method applied to the GPS receivers. Differential GPS in the early stage, the received signal from GPS was dealt with noise and pseudo range was measured by correlation processing, just like as VLBI. A new differential GPS receiver, called PRESTAR, has been developed by CRL, and is designed to be used in positioning and ionospheric measurement. PRESTAR reproduces the signal clocks and carriers from the received signal, and pseudo range is measured by the phase of them. We discussed about this system applied to the stability measurement of the atmosphere.

Author

Global Positioning System; Positioning; Systems Engineering

20000032023 Communications Research Lab., Tokyo, Japan

Precise Positioning Technique Using GPS, 1, Overview of Development of Prestar System

Sugimoto, Yuji, Communications Research Lab., Japan; Review of the Communications Research Laboratory; Dec. 1993; ISSN 0914-9279; Volume 39, No. 4, pp. 181-208; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This paper presents an overview of the development of the PRESTAR system, which is followed by papers describing its details. Geodesists and geophysicists have been awaiting the development of a small, inexpensive and precise positioning system that can be used for baselines up to several hundreds of kilometers. Global positioning system (GPS) is currently the best system for this purpose.

Derived from text

Positioning; Global Positioning System

20000032024 Communications Research Lab., Tokyo, Japan

Precise Positioning Technique Using GPS, 7, Results of the Experiments by "PRESTAR"

Takahashi, Yukio, Communications Research Lab., Japan; Sugimoto, Yuji, Communications Research Lab., Japan; Imae, Michito, Communications Research Lab., Japan; Kiuchi, Hitoshi, Communications Research Lab., Japan; Kaneko, Akihiro, Communications Research Lab., Japan; Kurihara, Noriyuki, Communications Research Lab., Japan; Review of the Communications Research Laboratory; Dec. 1993; ISSN 0914-9279; Volume 39, No. 4, pp. 247-255; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

We conducted many experiments using the Global Positioning System receiver "PRESTAR". "PRESTAR" is a unique receiver that receives only one Global Positioning System (GPS) satellite at each observation. The original data analysis software was developed to remove the phase ambiguity. The method to remove ambiguities and the results of experiments with PRESTAR are described. Its precision was found to be 5 mm and the ionospheric delay correction is possible. However, there remain some problems to obtain good data constantly.

Author

Global Positioning System; Positioning; Receivers

20000033433 National Central Univ., Center for Space and Remote Sensing Research, Chung-Li, Taiwan, Province of China
Ambiguity and Position Search Algorithms of GPS Carrier Phase Processing

Wu, Joz, National Central Univ., Taiwan, Province of China; Lin, Shiou-Gwo, National Central Univ., Taiwan, Province of China; Yiu, Fong-Gee, National Central Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers; Nov. 1997; ISSN 0253-3839; Volume 20, No. 6, pp. 643-650; In English; Sponsored in part by E-CTCI Corp.

Contract(s)/Grant(s): NSC-86-2621-E-008-004; Copyright; Avail: Issuing Activity

For high-precision GPS satellite positioning, two search algorithms are compared in this paper. One algorithm, which is based on an approach for resolving phase ambiguities, uses a least-squares search technique. The other algorithm is related to an ambiguity function method but differs from it in that the final positional convergence is achieved by employing the same least-squares technique. The search for a true position solution is conducted either in phase ambiguity space or in three-dimensional geometric space. The two algorithms are tested, using both single- and dual-frequency carrier phase measurements. The former phase processing is susceptible to cycle slips, but the latter has relatively small convergence ranges. Methodological performance for both rapid static and kinematic GPS positioning experiments is analyzed, leading not only to centimeter-level, but also comparable position solutions for short-range baselines. The algorithms can fulfill supportive functions, which increases the reliability of the GPS-based point determination.

Author

Global Positioning System; Algorithms; Navigation Satellites; Positioning; Ambiguity; Carrier Waves; Signal Processing

05

AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes all stages of design of aircraft and aircraft structures and systems. Also includes aircraft testing, performance, and evaluation, and aircraft and flight simulation technology.

20000027415 Boeing Co., Seattle, WA USA

Enhanced High AOA Maneuverability and Spin Recovery for the Super Hornet

Traven, Ricardo, Boeing Co., USA; Madenwald, Fred, Boeing Co., USA; Heller, Mike, Boeing Co., USA; Hoffman, Scott, Naval Surface Weapons Center, USA; 1999 Report to the Aerospace Profession: Forty Third Symposium Proceedings; September 1999, pp. 3-13; In English; See also 20000027414; Copyright; Avail: Issuing Activity

The F/A-18E/F Super Hornet incorporated several enhancements to high angle of attack maneuverability and controllability during the execution of the Engineering and Manufacturing Development (EMD) program. These modifications were developed and implemented in response to feedback from early operational assessments that indicated the Super Hornet had compromised some of the tactical utility available in the heritage F/A-18 aircraft by focusing too strongly on departure resistance. The combined efforts of the Boeing and Navy engineering team and the Integrated Test Team (ITT) responded to these challenges by adding the desired capabilities within the cost and schedule constraints of the EMD phase of the test program - providing those pilots with a highly-capable aircraft for the formal Operational Evaluation phase. These two design challenges are presented in this paper. First, the aircraft was designed to provide increased high AOA roll performance capability in an effort to meet next generation threats head-on. However, due to the increased departure resistance added to the Super Hornet, the operational pilots were not able to achieve desired performance during a critical close-in air combat maneuver. Second, spin recoveries were acceptable with symmetric loadings, but improvement was desired, if possible, with various levels of lateral weight asymmetries. While this was not a design requirement, the Super Hornet is expected to be employed routinely in asymmetric loadings to provide maximum mission flexibility. In addition to these issues, a brief background of the high angle of attack control law philosophy is presented, as well as lessons learned from these experiences.

Author

F-18 Aircraft; Aircraft Control; Maneuverability; Aircraft Maneuvers; Controllability; Control Theory; Flight Characteristics

20000027416 Saab-Space A.B., Linköping, Sweden

GRIPEN High AoA and Spin Auto-Recovery Testing

Sjöblom, Hans, Saab-Space A.B., Sweden; Johansson, Bjoern, FMV, Sweden; 1999 Report to the Aerospace Profession: Forty Third Symposium Proceedings; September 1999, pp. 14-32; In English; See also 20000027414; Copyright; Avail: Issuing Activity

Departure resistance including recovery from out of control flight-testing is something that most combat aircraft are tested for. Traditionally this kind of testing was of "trial and error" type since adequate simulation facilities were not available. Today, in a world of modern digital flight control systems and sophisticated simulators, most of this testing can be done in a safe and cost effective simulator environment. However, actual flight-testing is still required for aerodata identification and verification as well as spot checking of aircraft behavior. The Gripen high AoA flight test program has been conducted in Sweden. The program has covered aerodata identification at high AoA, departure resistance, spin investigation and spin auto-recovery testing. This paper describes our test objectives, test approach, test preparations, test results and lessons learned.

Author

Flight Tests; Spin Tests; Flight Control; Fighter Aircraft

20000027419 British Aerospace Public Ltd. Co., Warton, UK

Eurofighter Typhoon Carefree Handling Phase One Trial Problems

Hartley, Keith, British Aerospace Public Ltd. Co., UK; 1999 Report to the Aerospace Profession: Forty Third Symposium Proceedings; September 1999, pp. 81-85; In English; See also 20000027414; Copyright; Avail: Issuing Activity

As part of Typhoon's development program, Eurofighter have to demonstrate the aircraft's carefree handling qualities: by "carefree" I mean automatic departure and structural load protection, with no pilot-monitored handling or operating limitations. The programme requires a series of demonstrations as the aircraft capability and configurations expand; this paper is concerned with aspects of the first trials phase, completed last year. As well as being a crucial demonstration of our ability to provide carefree handling, these first trials were commercially very important - a successful first demonstration over an envelope agreed with the customer was an essential pre-requisite to him signing the first stages of the production contract. We therefore approached the trials in the usual flight test environment - tight timescales, lots of interest from the high-priced help, and a need to complete the programme within the commercial and contractual needs. The high AOA carefree handling testing is the responsibility of British Aerospace's flight test centre in Warton, England. The following paper discusses some of the problems that arose during the trial: although I'm obliged to get into some technical detail, the lessons learned apply to most areas of flight test.

Derived from text

Controllability; Aircraft Control; Maneuverability; Automatic Control

20000027420 Boeing Co., Seattle, WA USA

Developing the Crosswind Takeoff and Landing Envelope for the F/A-18E/F "Super Hornet"

Desmond, Dave, Boeing Co., USA; Melton, Henry, III, Naval Air Warfare Center, USA; Tribino, Michael A., Naval Air Warfare Center, USA; 1999 Report to the Aerospace Profession: Forty Third Symposium Proceedings; September 1999, pp. 86-97; In English; See also 20000027414; Copyright; Avail: Issuing Activity

Demonstration of the F/A-18 E/F "Super Hornet" crosswind takeoff and landing capability were required as part of the Engineering, Manufacturing and Development (EMD) program. A maximum crosswind takeoff and landing capability, to 30 kt, was desired to allow maximum flexibility for the fleet users for both symmetric and asymmetric store loadings. One of the many technical challenges of this flight test program included the development of a landing technique which would be recommended for the fleet pilots. This technique had to provide satisfactory approach handling qualities with acceptable pilot workload. Additionally, once on-deck, the landing loads at touchdown and the landing rollout characteristics were all critical to determining the optimum landing technique. Several crosswind landing techniques were evaluated. These included the wing-down-top-rudder (WDTR), crabbed, and crabbed approach and landing; with half and full-crab kickout just prior to touchdown. These tests were conducted at the Rogers Dry Lakebed, Edwards AFB, CA in the spring of 1998. Testing was scheduled at this facility because of the high natural winds and the availability of several lakebed runways, which would allow the test to be completed safely and efficiently. Due to the excellent aircraft flying qualities, performance, and favorable wind conditions, 38 demonstration crosswind takeoff and landings were completed in 9 days. The takeoff and landings were completed in three aircraft loadings with crosswind up to 30 knots. The most critical loading tested was the crosswind into the light wing of the airplane with 26,000 ft-lb lateral weight asymmetry. This paper will discuss the test setup, test technique, safety issues, results, and conclusions for the development of the crosswind takeoff and landing envelope of the F/A-18 E/F "Super Hornet".

Author

Wind Direction; Wind Velocity; Takeoff; F-18 Aircraft; Flight Tests; Aircraft Configurations; Aircraft Design

20000027421 Lockheed Martin Corp., Skunk Works, Palmdale, CA USA

"Give Me a Brake" F-117 Digital Brake Control Testing

Brown, James E., III, Lockheed Martin Corp., USA; 1999 Report to the Aerospace Profession: Forty Third Symposium Proceedings; September 1999, pp. 98-109; In English; See also 20000027414; Copyright; Avail: Issuing Activity

The F-117A Combined Test Force (CTF), Plant 42, Palmdale, CA conducted a developmental test of a new Digital Brake Control Box (DBCB) from October 1998 to March 1999. Developmental testing of the DBCB involved system functional checkout, taxi testing and increasing brake energy stops. The end point was a 100% brake energy Rejected Takeoff (RTO). What the contractor perceived as a quick form fit and function digital replacement for an existing analog system resulted in an extended and often problematic developmental test program. The DBCB test program resulted in a much enhanced brake and anti-skid control system for the F-117A aircraft. Additional functionality was provided to the pilot, failure modes were reduced and numerous troubleshooting benefits for the maintainer were realized. Lessons learned include thorough test planning, disciplined test conduct and the poor assumptions involved with the conversion of systems from analog to digital control.

Author

Digital Systems; Aircraft Brakes; Antiskid Devices; F-117A Aircraft; Braking; Systems Engineering

20000027426 National Test Pilot School, Mojave, CA USA

The USA Army XV-11A STOL Program

Roberts, Sean C., National Test Pilot School, USA; 1999 Report to the Aerospace Profession: Forty Third Symposium Proceedings; September 1999, pp. 156-174; In English; See also 20000027414; Copyright; Avail: Issuing Activity

This paper highlights the research efforts that culminated in the design and flight testing of the U.S. Army S.T.O.L. research vehicle.

Derived from text

Flight Tests; XV-11A Aircraft; X-1 Aircraft; Research and Development; Takeoff; Aircraft Performance

20000027427 NASA, Washington, DC USA

G-300 Unlimited Aerobatic Aircraft Development and Flight Test

Meyer, Robert, NASA, USA; Meyer, Marta, NASA, USA; 1999 Report to the Aerospace Profession: Forty Third Symposium Proceedings; September 1999, pp. 175-193; In English; See also 20000027414; Copyright; Avail: Issuing Activity

This paper will contain a brief description of competition aerobatics, the background for the development of the G-300, a description of the G-300 aircraft, a description of a high quality low cost data acquisition system, results of the flight test, and other interesting observations associated with the extreme agility of this aircraft. The interesting observations include, handling quality characteristics in all three axis, the authors qualitative assessment of the desirability of the reclined and elevated feet cockpit configuration, and the authors assessment of the practicality of very high roll rates for precision rolls required during competition aerobatics.

Derived from text

Aerobatics; Aircraft Design; Graphite; Composite Structures; Composite Materials; Airframe Materials; Airframes; Aircraft Performance; Flight Tests; Ground Tests

20000027429 Vision Air, Australia

Flight Without Legs: The Conception, Development and Certification of the "Vision Air" Hand Control

Duncan, Suzi, Vision Air, Australia; 1999 Report to the Aerospace Profession: Forty Third Symposium Proceedings; September 1999, pp. 205-209; In English; See also 20000027414; Copyright; Avail: Issuing Activity

"Vision Air" originally was to serve two purposes. One to make flying for the physically disabled as accessible as it is for the able bodied individual and secondly to raise money and therefore provide scholarships for those who are financially disadvantaged as well as physically disabled.

Derived from text

Certification; Pert; Management Methods; Project Management; Disabilities

20000027441 NASA Langley Research Center, Hampton, VA USA

Additional F-Functions Useful for Preliminary Design of Shaped-Signature, Low-Boom, Supersonic-Cruise Aircraft

Mack, Robert J., NASA Langley Research Center, USA; High-Speed Research: 1994 Sonic Boom Workshop. Configuration, Design, Analysis and Testing; December 1999, pp. 1-12; In English; See also 20000027440; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Two additional low-boom F-functions have been described for use in designing low-boom, shaped-pressure-signature, supersonic-cruise aircraft. Based on the minimization studies of Seebass and George, the drag-nose shock strength trade-off modification of Darden, and the practical modification of Haglund, their use can aid in the design of conceptual low-boom aircraft, provide additional flexibility in the shaping of the low-boom aircraft nose section, and extend the applicability of shaped-pressure-signature methodology.

Author

Sonic Booms; Aircraft Design; Supersonic Aircraft; Aerodynamic Configurations; Bodies of Revolution; Noses (Forebodies)

20000027449 NASA Langley Research Center, Hampton, VA USA

A Performance Assessment of Eight Low-Boom High-Speed Civil Transport Concepts

Baize, Daniel G., NASA Langley Research Center, USA; McElroy, Marcus O., NASA Langley Research Center, USA; Fenbert, James A., NASA Langley Research Center, USA; Coen, Peter G., NASA Langley Research Center, USA; Ozoroski, Lori P., Lockheed Engineering and Sciences Co., USA; Domack, Chris S., Lockheed Engineering and Sciences Co., USA; Needleman, Kathy E., Lockheed Engineering and Sciences Co., USA; Geiselhart, Karl A., Lockheed Engineering and Sciences Co., USA; High-Speed Research: 1994 Sonic Boom Workshop. Configuration, Design, Analysis and Testing; December 1999, pp. 149-170; In English; See also 20000027440; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

A performance assessment of eight low-boom high speed civil transport (HSCT) configurations and a reference HSCT configuration has been performed. Although each of the configurations was designed with different engine concepts, for consistency, a year 2005 technology, 0.4 bypass ratio mixed-flow turbofan (MFTF) engine was used for all of the performance assessments. Therefore, all original configuration nacelles were replaced by a year 2005 MFRF nacelle design which corresponds to the engine deck utilized. The engine thrust level was optimized to minimize vehicle takeoff gross weight. to preserve the configuration's sonic-boom shaping, wing area was not optimized or altered from its original design value. Performance sizings were completed when possible for takeoff balanced field lengths of 11,000 ft and 12,000 ft, not considering FAR Part 36 Stage III noise compliance. Additionally, an arbitrary sizing with thrust-to-weight ratio equal to 0.25 was performed, enabling performance levels to be compared independent of takeoff characteristics. The low-boom configurations analyzed included designs from the Boeing Commercial Airplane Group, Douglas Aircraft Company, Ames Research Center, and Langley Research Center. This paper discusses the technology level assumptions, mission profile, analysis methodologies, and the results of the assessment. The results include maximum lift-to-drag ratios, total fuel consumption, number of passengers, optimum engine sizing plots, takeoff performance, mission block time, and takeoff gross weight for all configurations. Results from the low-boom configurations are also compared with a non-low-boom reference configuration. Configuration dependent advantages or deficiencies are discussed as warranted.

Author

Sonic Booms; Supersonic Transports; Aircraft Design; Aircraft Configurations; Aircraft Structures; Aerodynamic Configurations; Propulsion System Configurations

20000027450 NASA Dryden Flight Research Center, Edwards, CA USA

Measurements of the Basic SR-71 Airplane Near-Field Signature

Haering, Edward A., Jr., NASA Dryden Flight Research Center, USA; Whitmore, Stephen A., NASA Dryden Flight Research Center, USA; Ehernberger, L. J., NASA Dryden Flight Research Center, USA; High-Speed Research: 1994 Sonic Boom Workshop. Configuration, Design, Analysis and Testing; December 1999, pp. 171-197; In English; See also 20000027440; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Airplane design studies have developed configuration concepts that may produce lower sonic boom annoyance levels. Since lower noise designs differ significantly from other HSCT designs, it is necessary to accurately assess their potential before HSCT final configuration decisions are made. Flight tests to demonstrate lower noise design capability by modifying an existing airframe have been proposed for the Mach 3 SR-71 reconnaissance airplane. to support the modified SR-71 proposal, baseline in-flight measurements were made of the unmodified aircraft. These measurements of SR-71 near-field sonic boom signatures were obtained by an F-16XL probe airplane at flightpath separation distances ranging from approximately 740 to 40 ft. This paper discusses the methods used to gather and analyze the flight data, and makes comparisons of these flight data with CFD results from Douglas Aircraft Corporation and NASA Langley Research Center. The CFD solutions were obtained for the near-field flow about the SR-71, and then propagated to the flight test measurement location using the program MDBOOM.

Derived from text

Flight Tests; Near Fields; Sonic Booms; Supersonic Transports; SR-71 Aircraft; Aircraft Design; In-Flight Monitoring; Aerodynamic Configurations

20000027453 NASA Dryden Flight Research Center, Edwards, CA USA

Low-Boom SR-71 Modified Signature Demonstration Program

Lux, David, NASA Dryden Flight Research Center, USA; Ehernberger, L. J., NASA Dryden Flight Research Center, USA; Moes, Timothy R., NASA Dryden Flight Research Center, USA; Haering, Edward A., NASA Dryden Flight Research Center, USA; High-Speed Research: 1994 Sonic Boom Workshop. Configuration, Design, Analysis and Testing; December 1999, pp. 237-248; In English; See also 20000027440; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

A flight program using the SR-71 airplane to validate sonic boom technologies for High-Speed Commercial Transport (HSCT) operation and potentially for low- or softened-boom design configurations is described. This program employs a shaped signature modification to the SR-71 airplane which is designed to demonstrate computational fluid dynamics (CFD) design technology at a full-scale HSCT operating condition of Mach 1.8 at 48,000 feet altitude. Test plans call for measurements in the near-field, at intermediate propagation altitudes, and through the more turbulent boundary layer near the Earth surface. The shaped signature modification to the airplane is comprised of added cross-section areas on the underside of the airplane forward of the wing and engine nacelles. Because the flight demonstration does not approach maximum SR-71 altitude or Mach number, the airplane provides more than adequate performance and maneuver margins for safe operation of the modified airplane. Probe airplane measurements in the near-field will use fast response pressure sensors. Far-field and ground-based boom measurements will use high response microphones or conventional sonic boom field recorders. Scope of the planned demonstration flights also includes ground level measurements during conditions which cause minimal signature distortion and conditions which cause high distortion of the signature.

Author

Sonic Booms; SR-71 Aircraft; Flight Tests; Supersonic Transports; Turbulent Boundary Layer; Aircraft Design; Design Analysis

20000027614 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne Australia

Estimation of Structural Component Loads in Helicopters: A Review of Current Methodologies

Polanco, Frank G.; Dec. 1999; 40p; In English

Report No.(s): AD-A372893; DSTO-TN-0239; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A review of the literature for models that use fixed component loads and flight parameters to determine loads in a dynamic component is presented. The reviewed papers naturally divide into one of three categories depending on the information they use to determine the load in the dynamic component. An initial section on load variability demonstrates that even for the same aircraft under the same flight condition, the loading can vary dramatically due to pilot technique, altitude, and weight to name a few variables. Neural networks, regression, and statistical indicators prove invaluable in developing load models. The review also demonstrated a lack of solutions to fundamental questions concerning loads modelling.

DTIC

Loads (Forces); Structural Analysis

20000027686 Office National d'Etudes et de Recherches Aerospatiales, Chatillon, France

Aerodynamic Performance Analysis of the Hypersonic Airbreathing Vehicle JAPHAR

Dueveau, P., Office National d'Etudes et de Recherches Aerospatiales, France; Hallard, R., Office National d'Etudes et de Recherches Aerospatiales, France; Novelli, P., Office National d'Etudes et de Recherches Aerospatiales, France; Eggers, T., Office National d'Etudes et de Recherches Aerospatiales, France; Sep. 10, 1999; 11p; In English; Prepared in cooperation with DLR, Braunschweig, Germany.

Report No.(s): AD-A373370; ISABE-99-7286; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

In 1997, DLR and ONERA joined in a common project called JAPHAR (Joint Airbreathing Propulsion for Hypersonic Application Research). The main objective of this project is to develop and test at ground a dual mode ramjet engine (DMR) combining both subsonic and supersonic combustion regimes. The other objective is to define a methodology to establish the thrust-minus-drag balance of the DMR on an experimental vehicle to be flown between Mach number 4 and 8. This paper presents an ongoing effort for the design of an integrated propulsive system for JAPHAR flight test vehicle. Forebody, inlet and nozzle aerodynamic studies are conducted in close connection with the system studies and require CFD analysis as well as wind tunnel experiments. A forebody parametric study based on turbulent Navier-Stokes calculations was conducted at ONERA. The main results are given in the paper, demonstrating the advantage of DLR waverider forebody. In addition, this paper gives an overview of the inlet studies conducted so far at ONERA. An internal compression inlet was designed and tested in S3MA wind tunnel, between Mach 3 and 5.5. Navier-Stokes calculations are in progress to calibrate numerical codes and to provide combustion people

with realistic entry flow field conditions. Lastly, a preliminary design of a SERN nozzle (Single Expansion Ramp Nozzle) relying on inviscid calculations is presented.

DTIC

Aerodynamic Characteristics; Air Breathing Engines; Navier-Stokes Equation; Hypersonic Vehicles; Supersonic Combustion; Supersonic Speed; Inviscid Flow; Flight Test Vehicles

20000031341 Dayton Univ. Research Inst., Research Inst., OH USA

Preliminary Recommendation for the Electronic Display of Graphical Aircraft Maintenance Information *Interim Report, Nov. 1995-Feb. 1999*

Quill, Laurie; Kancler, David; Pohle, Patrick; Masquelier, Barbara L.; Feb. 1999; 19p; In English

Contract(s)/Grant(s): F41624-98-F-5017; AF Proj. 1710

Report No.(s): AD-A373566; AFRL-HE-WP-TR-1999-0196; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The conversion of paper schematic diagrams to electronic display presentations requires identification and analysis of associated cognitive demands. Schematic diagrams are typically used by expert maintainers in troubleshooting aircraft faults. These expert maintainers must rely on skill, rule, and knowledge-based behavior to successfully use these diagrams. In this task, the Applied Cognitive Task Analysis (ACTA) method was employed to elicit knowledge associated with using schematic diagrams for troubleshooting. Eleven F-15 maintenance technicians were interviewed. Results showed that schematic diagrams not only support the basic abilities required for troubleshooting; they also allow for visualization of the dynamic flow of system relations and process activities on the aircraft. The ACTA method identified the cues and strategies used to mentally depict system flow. Efforts to convert schematic diagrams to electronic display presentations should support the basic troubleshooting abilities, as well as the cues and strategies that depict dynamic system flow.

DTIC

Aircraft Maintenance; Display Devices

20000031539 Boeing Co., Long Beach, CA USA

TCA Full Configuration Performance and S and C Characteristics

Martin, Grant L., Boeing Co., USA; Mendoza, Raul, Boeing Co., USA; Kubiak, Paul, Boeing Co., USA; Agrawal, Shreekanth, Boeing Co., USA; 1998 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 1, Part 1, pp. 205-286; In English; See also 20000031532; Original contains color illustrations; No Copyright; Avail: CASI; A05, Hardcopy; A10, Microfiche

During the past year, Boeing Long Beach has made major strides in Computational Fluid Dynamics (CFD) analysis of increasingly complex HSCT configurations using both serial and parallel computational platforms. Presented herein are full configuration Euler and Navier-Stokes solutions obtained using CFL3D on the NAS C-90, J-90, IBM SP-2, Cray T3E, and SGI Origin2000. Solutions were obtained for the 1.675% TCA wing/body (W/B), wing/body/empennage (W/B/E), wing/body/nacelle/diverter (W/B/N/D), and the full configuration (W/B/N/D/E). Other CFL3D full configuration computations were performed on the 1.5% Modular Controls Model to assess the longitudinal and lateral-directional characteristics of the TCA at M (sub infinity) = 2.4. Limited full configuration predictions were obtained at M (sub infinity) = 0.9. In order to validate the predicted force and moments, a number of comparisons are made between predicted results and the available test data from the NASA Langley Unitary Plan Wind Tunnel (UPWT) and the transonic 16' TT facility.

Author

Technology Utilization; Computational Fluid Dynamics; Performance Prediction; Control Stability; Wing Nacelle Configurations; Body-Wing and Tail Configurations

20000031719 Federal Aviation Administration, Atlantic City, NJ USA

Vertical Drop Test of a Shorts 3-30 Airplane *Final Report*

Abramowitz, Allan; Ingraham, Philip A.; McGuire, Robert; Nov. 1999; 121p; In English

Report No.(s): AD-A373749; DOT/FAA/AR-99/87; No Copyright; Avail: CASI; A02, Microfiche; A06, Hardcopy

A Short Brothers PLC, Model SD 3-30, airplane was subjected to a vertical impact drop test at the Federal Aviation Administration (FAA) William J. Hughes Technical Center, Atlantic City International Airport, New Jersey. The objective of the test was to determine the impact response of the fuselage, seat tracks, seats, and anthropomorphic test dummies on a high-wing, commuter type airplane. The test was conducted to simulate the vertical velocity component of a severe, but survivable, crash impact. A final impact velocity of 30 feet per second was therefore selected. The airplane was configured in a typical maximum gross weight flight condition, including seats, simulated occupants, fuel, and cargo. The Shorts 3.30 is a twin turboprop, 30-passenger regional transport airplane. The total test weight of the airplane was 21,210 pounds. The internal seating

arrangement consisted of pilot and copilot seats, eight rows of standard passenger seats, and two nonstandard seats mounted in the aisle. Twentyone of the 28 seats were occupied by mannequins; the remaining seven seats were occupied by instrumented anthropomorphic test dummies. The Shorts 3-30 fuel system is unique insofar as the two fuel tanks are located on top of the fuselage as opposed to the more conventional location in the wings. During the drop test, a massive amount of simulated fuel spilled into the passenger compartment. The stiff structure of the airplane allowed for only small amounts of airframe crushing. As a result, the fuselage experienced high G(max) levels of approximately 90 g's with an impact pulse duration of 15 ins. The stiff structure also prevented fuselage crushing which allowed the airplane to maintain a protective shell. The seat tracks remained attached to the fuselage. However, 23 of the 26 passenger seats experienced structural failure. The crew seats were undamaged.

DTIC

Drop Tests; Crashes; Impact Tests; Crashworthiness

20000032041 RAND Corp., Santa Monica, CA USA

Aging Aircraft: Implications for Programmed Depot Maintenance and Engine-Support Costs

Pyles, Raymond; Feb. 1999; 11p; In English

Report No.(s): AD-A373688; RAND-CT-149; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

RAND Project AIR FORCE'S long term interest in the topic of aging aircraft was rekindled in 1994, when we participated in the Air Force Scientific Advisory Board Summer Study that raised technical concerns about the viability of retaining certain aircraft past their original design lives. In 1997, the National Research Council's report on aging USAF aircraft reinforced those concerns. At that time, we initiated a modest Air Force sponsored research effort focused on emerging technical challenges for aircraft maintenance activities. Last summer we built on that technical background to examine the potential effects that aging aircraft would have on the costs of programmed depot maintenance (PDM) and engine support. The results of that work are documented in the annotated briefing that has been made available to the subcommittee. This year, we have broadened our review to cover other support and modernization activities where aircraft age may affect costs and readiness.

DTIC

Aircraft Maintenance; Life Cycle Costs; Logistics Management

20000032437 Florida Univ., Dept. of Aerospace Engineering, Mechanics and Engineering Science, Gainesville, FL USA

Adjoint Techniques for Topology Optimization of Structures Under Damage Conditions

Akgun, Mehmet A., Florida Univ., USA; Haftka, Raphael T., Florida Univ., USA; March 2000; 3p; In English

Contract(s)/Grant(s): NCC1-268; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective of this cooperative agreement was to seek computationally efficient ways to optimize aerospace structures subject to damage tolerance criteria. Optimization was to involve sizing as well as topology optimization. The work was done in collaboration with Steve Scotti, Chauncey Wu and Joanne Walsh at the NASA Langley Research Center. Computation of constraint sensitivity is normally the most time-consuming step of an optimization procedure. The cooperative work first focused on this issue and implemented the adjoint method of sensitivity computation (Haftka and Gurdal, 1992) in an optimization code (runstream) written in Engineering Analysis Language (EAL). The method was implemented both for bar and plate elements including buckling sensitivity for the latter. Lumping of constraints was investigated as a means to reduce the computational cost. Adjoint sensitivity computation was developed and implemented for lumped stress and buckling constraints. Cost of the direct method and the adjoint method was compared for various structures with and without lumping. The results were reported in two papers (Akgun et al., 1998a and 1999). It is desirable to optimize topology of an aerospace structure subject to a large number of damage scenarios so that a damage tolerant structure is obtained. Including damage scenarios in the design procedure is critical in order to avoid large mass penalties at later stages (Haftka et al., 1983). A common method for topology optimization is that of compliance minimization (Bendsoe, 1995) which has not been used for damage tolerant design. In the present work, topology optimization is treated as a conventional problem aiming to minimize the weight subject to stress constraints. Multiple damage configurations (scenarios) are considered. Each configuration has its own structural stiffness matrix and, normally, requires factoring of the matrix and solution of the system of equations. Damage that is expected to be tolerated is local and represents a small change in the stiffness matrix compared to the baseline (undamaged) structure. The exact solution to a slightly modified set of equations can be obtained from the baseline solution economically without actually solving the modified system.. Shennan-Morrison-Woodbury (SMW) formulas are matrix update formulas that allow this (Akgun et al., 1998b). SMW formulas were therefore used here to compute adjoint displacements for sensitivity computation and structural displacements in damaged configurations.

Author

Damage; Aircraft Structures; Optimization; Topology

20000032524 NASA Langley Research Center, Hampton, VA USA

Concept Development of a Mach 1.6 High-Speed Civil Transport

Shields, Elwood W., Lockheed Engineering and Sciences Co., USA; Fenbert, James W., NASA Langley Research Center, USA; Ozoroski, Lori P., Lockheed Engineering and Sciences Co., USA; Geiselhart, Karl A., Lockheed Engineering and Sciences Co., USA; December 1999; 26p; In English

Contract(s)/Grant(s): RTOP 537-03-22-02

Report No.(s): NASA/TP-1999-209697; NAS 1.60:209697; L-17242; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A high-speed civil transport configuration with a Mach number of 1.6 was developed as part of the NASA High-Speed Research Program to serve as a baseline for assessing advanced technologies required for an aircraft with a service entry date of 2005. This configuration offered more favorable solutions to environmental concerns than configurations with higher Mach numbers. The Mach 1.6 configuration was designed for a 6500 n.mi. mission with a 250-passenger payload. The baseline configuration has a wing area of 8732 square feet a takeoff gross weight of 591570 lb, and four 41000-lb advanced turbine bypass engines defined by NASA. These engines have axisymmetric mixer-ejector nozzles that are assumed to yield 20 dB of noise suppression during takeoff, which is assumed to satisfy, the FAR Stage III noise requirements. Any substantial reduction in this assumed level of suppression would require oversizing the engines to meet community noise regulations and would severely impact the gross weight of the aircraft at takeoff. These engines yield a ratio of takeoff thrust to weight of 0.277 and a takeoff wing loading of 67.8 lb/square feet that results in a rotation speed of 169 knots. The approach velocity of the sized configuration at the end of the mission is 131 knots. The baseline configuration was resized with an engine having a projected life of 9000 hr for hot rotating parts and 18000 hr for the rest of the engine, as required for commercial use on an aircraft with a service entry date of 2005. Results show an increase in vehicle takeoff gross weight of approximately 58700 lb. This report presents the details of the configuration development, mass properties, aerodynamic design, propulsion system and integration, mission performance, and sizing.

Author

Mach Number; Supersonic Speed; Aerodynamic Configurations; Turbine Engines; Weight (Mass); Civil Aviation

20000032553 NASA Langley Research Center, Hampton, VA USA

IMAGE: A Design Integration Framework Applied to the High Speed Civil Transport

Hale, Mark A., NASA Langley Research Center, USA; Craig, James I., Georgia Inst. of Tech., USA; [1993]; 6p; In English; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Effective design of the High Speed Civil Transport requires the systematic application of design resources throughout a product's life-cycle. Information obtained from the use of these resources is used for the decision-making processes of Concurrent Engineering. Integrated computing environments facilitate the acquisition, organization, and use of required information. State-of-the-art computing technologies provide the basis for the Intelligent Multi-disciplinary Aircraft Generation Environment (IMAGE) described in this paper. IMAGE builds upon existing agent technologies by adding a new component called a model. With the addition of a model, the agent can provide accountable resource utilization in the presence of increasing design fidelity. The development of a zeroth-order agent is used to illustrate agent fundamentals. Using a CATIA(TM)-based agent from previous work, a High Speed Civil Transport visualization system linking CATIA, FLOPS, and ASTROS will be shown. These examples illustrate the important role of the agent technologies used to implement IMAGE, and together they demonstrate that IMAGE can provide an integrated computing environment for the design of the High Speed Civil Transport.

Author

Concurrent Engineering; Supersonic Transports; Systems Engineering; Aircraft Design; Computer Aided Design; Computer Aided Manufacturing; Multidisciplinary Research

20000032560 Georgia Inst. of Tech., Atlanta, GA USA

A Multilevel Decomposition Procedure for the Preliminary Wing Design of a High-Speed Civil Transport Aircraft

Rohl, Peter J., Georgia Inst. of Tech., USA; Marvis, Dimitri N., Georgia Inst. of Tech., USA; Schrage, Daniel P., Georgia Inst. of Tech., USA; 1994; 7p; In English; 1st; High Speed Civil Transport Vehicles, December 1994, Greensboro, NC, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A multilevel decomposition approach for the preliminary design of a High Speed Civil Transport Aircraft wing structure is described. The wing design is decomposed into three levels. The top level uses the FLOPS aircraft synthesis program to generate preliminary weights, mission, and performance information. The optimization criterion is productivity expressed by a productivity index for the specified mission. The second level of the system performs a finite-element based structural optimization of the wing box with the help of the ASTROS structural optimization tool. The wing structure is sized subject to

strength, buckling, and aeroelastic constraints. The buckling constraint information is supplied by the third level where a detailed buckling optimization of individual skin cover panels is performed.

Author

Aircraft Design; Supersonic Transports; Wings; Multidisciplinary Design Optimization; Systems Engineering; Computer Aided Design

20000032561 NASA Langley Research Center, Hampton, VA USA

Integrating Design and Manufacturing for a High Speed Civil Transport Wing

Marx, William J., NASA Langley Research Center, USA; Mavris, Dimitri N., Georgia Inst. of Tech., USA; Schrage, Daniel P., Georgia Inst. of Tech., USA; 1994; 10p; In English; 19th; Aircraft Systems, Sep. 1994, Anaheim, CA, USA; Sponsored by International Council of the Aeronautical Sciences; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The aerospace industry is currently addressing the problem of integrating design and manufacturing. Because of the difficulties associated with using conventional, procedural techniques and algorithms, it is the authors' belief that the only feasible way to integrate the two concepts is with the development of an appropriate Knowledge-Based System (KBS). The authors propose a methodology for an aircraft producibility assessment, including a KBS, that addresses both procedural and heuristic aspects of integrating design and manufacturing of a High Speed Civil Transport (HSCT) wing. The HSCT was chosen as the focus of this investigation since it is a current NASA/aerospace industry initiative full of technological challenges involving many disciplines. The paper gives a brief background of selected previous supersonic transport studies followed by descriptions of key relevant design and manufacturing methodologies. Georgia Tech's Concurrent Engineering/Integrated Product and Process Development methodology is discussed with reference to this proposed conceptual producibility assessment. Evaluation criteria are presented that relate pertinent product and process parameters to overall product producibility. In addition, the authors' integration methodology and reasons for selecting a KBS to integrate design and manufacturing are presented in this paper. Finally, a proposed KBS is given, as well as statements of future work and overall investigation objectives.

Author

Concurrent Engineering; Knowledge Based Systems; Supersonic Transports; Wings; Aircraft Design; Systems Engineering; Computer Aided Manufacturing; Computer Aided Design

20000032562 NASA Langley Research Center, Hampton, VA USA

Knowledge-Based Manufacturing and Structural Design for a High Speed Civil Transport

Marx, William J., NASA Langley Research Center, USA; Mavris, Dimitri N., Georgia Inst. of Tech., USA; Schrage, Daniel P., Georgia Inst. of Tech., USA; 1994; 6p; In English; 1st; Research for Future Supersonic and Hypersonic Vehicles, Dec. 1994, Greensboro, NC, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The aerospace industry is currently addressing the problem of integrating manufacturing and design. to address the difficulties associated with using many conventional procedural techniques and algorithms, one feasible way to integrate the two concepts is with the development of an appropriate Knowledge-Based System (KBS). The authors present their reasons for selecting a KBS to integrate design and manufacturing. A methodology for an aircraft producibility assessment is proposed, utilizing a KBS for manufacturing process selection, that addresses both procedural and heuristic aspects of designing and manufacturing of a High Speed Civil Transport (HSCT) wing. A cost model is discussed that would allow system level trades utilizing information describing the material characteristics as well as the manufacturing process selections. Statements of future work conclude the paper.

Author

Knowledge Based Systems; Computer Aided Manufacturing; Expert Systems; Mathematical Models; Structural Design; Supersonic Transports; Decision Support Systems

20000032581 NASA Langley Research Center, Hampton, VA USA

Simulation of X-38 Landing Scenarios With Landing Gear Failures

Fasanella, Edwin L., Army Research Lab., USA; Lyle, Karen H., Army Research Lab., USA; Pritchard, Jocelyn I., Army Research Lab., USA; Stockwell, Alan E., Lockheed Martin Engineering and Science Services, USA; March 2000; 41p; In English
Contract(s)/Grant(s): RTOP 577-50-10-01

Report No.(s): NASA/TM-2000-210078; NAS 1.15:210078; L-17935; ARL-TR-2144; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Abnormal landing scenarios of the X-38 prototype Crew Rescue Vehicle (CRV) were modeled for three different cases involving non-deployment of landing gear with an explicit dynamic nonlinear finite element code, MSC/DYTRAN. The goal of this research was to develop models to predict the probability of crew injuries. The initial velocity conditions for the X-38 with

chute deployed were 10 ft/s vertical and 57 ft/s longitudinal velocity. An MSC/NASTRAN structural model was supplied by JSC and was converted to a dynamic MSC/DYTRAN model. The MSC/NASTRAN model did not include seats or floor structure; thus, the acceleration of a lumped-mass attached to the bulkhead near each assumed occupant location was used to determine injury risk for each occupant. The worst case for injury was nondeployment of all gears. The mildest case was nondeployment of one main gear. Although a probability for minor injury was predicted for all cases, it is expected that the addition of energy-absorbing floor structure and seats would greatly diminish the probability of injury.

Author

Computerized Simulation; Flight Simulation; X-38 Crew Return Vehicle; Rescue Operations; Landing Gear; Failure

20000032684 Asian Office of Aerospace Research and Development, Tokyo, Japan

Operational Need

Lyons, T. J., Asian Office of Aerospace Research and Development, Japan; Human Consequences of Agile Aircraft; March 2000, pp. 1 - 1 - 1 - 4; In English; See also 20000032683; Copyright Waived; Avail: CASI; A01, Hardcopy

Between April 1997 and October 1998, Working Group #27 conducted discussions with experienced military fighter pilots and test pilots concerning the human factor implications of agile aircraft flight. Aircrews interviewed included 23 U.S. pilots (consisting of 5 NASA Test Pilots, 13 USAF Air Warfare Center Pilots, and 5 USAF Pilot-Physicians), 11 Swedish Air Force operational pilots, 3 German Air Force test pilots, and 2 French pilots. After the discussions, the aircrews were asked to complete an anonymous questionnaire. (Note, the French pilots were interviewed before the questionnaire was completed and so their views are represented in the pilot comments, but not in the actual questionnaire results.) In addition to the questionnaire results, one-on-one interviews were conducted with many of the pilots. A world wide representation of most agile aircraft was achieved by surveying pilots experienced with the X-31, F-18 HARV, F-15 Active, MATV, Harrier, F-22, F-18, MIG-29, Rafale, Gripen, and Eurofighter. As a part of the questionnaire, the aircrew members were asked background questions concerning their flying experience. The remainder of the questionnaire involved rating the utility of various aircraft capabilities (e.g., high AOA/post-stall maneuvering, negative G maneuvering, high (+12) Gz maneuvering) with regard to their contribution to air-to-air combat performance. A seven point scale was used to rate the perceived contributions to air combat effectiveness. Specifically, ratings ranged from 1 for "Not at all useful", 3 for "Slightly useful", 5 for "Moderately useful", to 7 for "Very useful." The aircrews were, on the average, very experienced with an average flying time of 2,589 hours (range 900-9,000). Note that some pilots did not have experience with helmet mounted sights or advanced anti-G suits. Hence, they did not rate these systems. Combat Edge (the USAF positive pressure breathing system for G protection) and the Advanced Technology Anti-G suit were included as known benchmarks against which to judge the pilot responses. Pilots rated helmet-mounted sights, high AOA maneuvering, and high G capability all highly. Ratings of negative Gs varied widely among the responders. Some interesting differences were noted in the responses of the Swedish pilots compared with the U.S. and German pilots. On the average, Swedish pilots valued airframe agility (capability to pull +12 Gz and -Gz) less. This could be due to several factors including: (1) lower average flying experience (flying hours) in the Swedish pilots interviewed; (2) the Swedish pilots included mainly operational pilots rather than test pilots; or (3) national differences. In summary, the pilots surveyed viewed the capabilities afforded by agile aircraft as useful for combat. The following sections provide additional detail from the questionnaire data and debriefing comments that specifically pertains to human factors issues, including physiologic problems, the pilot-vehicle interface, selection, and training. The final section reexamines the pilots' view of agile flight.

Author

Aircraft Pilots; Human Factors Engineering; Surveys; Aircraft Equipment; Flight Instruments; Physiological Factors; Pilot Performance

20000032860 NASA Langley Research Center, Hampton, VA USA

The Significance of Small Cracks in Fatigue Design Concepts as Related to Rotorcraft Metallic Dynamic Components

Everett, R. A., Jr., NASA Langley Research Center, USA; Elber, W., NASA Langley Research Center, USA; Application of Damage Tolerance Principles for Improved Airworthiness of Rotorcraft; February 2000, pp. 1 - 1 - 1 - 14; In English; See also 20000032859; Copyright Waived; Avail: CASI; A03, Hardcopy

In this paper the significance of the "small" crack effect as defined in fracture mechanics will be discussed as it relates to life managing rotorcraft dynamic components using the conventional safe-life, the flaw tolerant safe-life, and the damage tolerance design philosophies. These topics will be introduced starting with an explanation of the small-crack theory, then showing how small-crack theory has been used to predict the total fatigue life of fatigue laboratory test coupons with and without flaws, and concluding with how small cracks can affect the crack-growth damage tolerance design philosophy. As stated in this paper the "small" crack effect is defined in fracture mechanics where it has been observed that cracks on the order of 300 microns or less in length will propagate at higher growth rates than long cracks and also will grow at AK values below the long crack AK threshold.

The small-crack effect is illustrated herein as resulting from a lack of crack closure and is explained based on continuum mechanics principles using crack-closure concepts in fracture mechanics.

Author

Crack Propagation; Cracks; Damage; Fatigue Life; Fatigue Tests; Fracture Mechanics; Rotary Wing Aircraft; Tolerances (Mechanics); Aircraft Reliability

20000032869 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA

The US Navy's Helicopter Integrated Diagnostics System (HIDS) Program: Power Drive Train Crack Detection Diagnostics and Prognostics, Life Usage Monitoring, and Damage Tolerance; Techniques, Methodologies, and Experiences

Hess, Andrew, Naval Air Warfare Center, USA; Hardman, William, Naval Air Warfare Center, USA; Chin, Harrison, Goodrich (B. F.) Aerospace, USA; Gill, John, Goodrich (B. F.) Aerospace, USA; Application of Damage Tolerance Principles for Improved Airworthiness of Rotorcraft; February 2000, pp. 13 - 1 - 13 - 22; In English; See also 20000032859; Copyright Waived; Avail: CASI; A03, Hardcopy

The evolution of automated diagnostic systems for helicopter mechanical systems has been greatly advanced by the Navy, in a program of systematic testing of drive train components having known anomalies (seeded faults) while simultaneously executing a suite of diagnostic techniques to identify and classify the mechanical anomalies. This program, called the Helicopter Integrated Diagnostic System (HIDS) was carried out using both an iron bird test stand and SH-60B/F flight vehicles. The SH-60 HIDS program has been the Navy's cornerstone effort to develop, demonstrate, and justify integrated mechanical diagnostic system capabilities for its various helicopter fleets. The objectives of the original program were to: (1) Acquire raw data for multiple cases of "good" and seeded fault mechanical components on a fully instrumented drive train to support the evaluation of diagnostic algorithms and fault isolation matrices. Data is being acquired from 32 vibration channels simultaneously at 100 kHz per channel while a continuous usage monitoring system records parametric steady state data from the power plant and airframe. (2) Analyze vibration and other diagnostic indicators to evaluate sensitivity and performance of all available diagnostic methods when analyzing well-documented parts and their associated failure modes. Evaluate relative effectiveness of these various diagnostic methods, indicators, and their associated algorithms to identify and optimize sensor location combinations. (3) Demonstrate the ability to integrate and automate the data acquisition, diagnostic, fault evaluation and communication processes in a flight worthy system. (4) Integrate and evaluate comprehensive engine monitoring, gearbox and drive train vibration diagnostics, advanced oil debris monitoring, in-flight rotor track and balance, parts life usage tracking, automated flight regime recognition, power assurance checks and trending, and automated maintenance forecasting in a well-coordinated on-board and ground-based system. (5) Provide an extensive library of high quality vibration data on baseline and seeded fault components. This data can be made available to anyone wanting to prove their diagnostic techniques or develop new capability. (6) Provide a "showcase", state-of-the-art, fully functional Integrated Mechanical Diagnostic system to act as a catalyst demonstration which might lead to interest in a fleet wide production application. This paper will describe the HIDS program background, development, system capabilities, and accomplishments; but will also focus on the most recent demonstrated drive train crack detection diagnostic techniques; aircraft component life usage monitoring philosophies and capabilities; and damage tolerance methodologies. Data and results from both the seeded fault "iron bird" test cell rig and flight test aircraft will be presented. Experience, results, and lessons learned will be emphasized. HIDS initiated functions and capabilities being applied to the commercial off-the-shelf (COTS) SH-60 Integrated Mechanical Diagnostics System (IMDS) production program will be described. Conclusions and lessons learned that can be applied to future Helicopter Usage Monitoring Systems (HUMS) and/or Integrated Mechanical Diagnostic (IMD) systems will also be discussed.

Author

Systems Health Monitoring; Helicopters; Tolerances (Mechanics); Rotor Aerodynamics; Failure Modes; Flight Tests; Aircraft Reliability

20000032872 Federal Aviation Administration, Los Angeles Aircraft Certification Office, Lakewood, CA USA

Strategies for Ensuring Rotorcraft Structural Integrity

Eastin, Robert G., Federal Aviation Administration, USA; Application of Damage Tolerance Principles for Improved Airworthiness of Rotorcraft; February 2000, pp. 17 - 1 - 17 - 6; In English; See also 20000032859; Copyright Waived; Avail: CASI; A02, Hardcopy

Part 29.571 contains several strategies that, with certain qualification, applicants are allowed to adopt to ensure adequate structural integrity throughout the operational life of a rotorcraft. There has been a continuing debate concerning the merits of the various strategies. Much of the discussion has centered on the damage tolerance versus the flaw tolerance philosophies and the pros and cons of each. Additionally, the appropriate role of the traditional safe-life philosophy has been debated at length. This

paper begins by considering what the objective of Part 29.571 is and then examines each of the strategies and their strengths and weaknesses. Following this a recommended strategy is proposed which is believed to offer the most rational path at the present time to achieving the stated objective.

Derived from text

Damage; Rotary Wing Aircraft; Structural Failure; Tolerances (Mechanics); Structural Reliability; Aircraft Structures; Systems Health Monitoring; Cracks

20000032874 Westland Helicopters Ltd., Yeovil, UK

Application of Damage Tolerance to the EH101 Airframe

Matthew, David, Westland Helicopters Ltd., UK; Application of Damage Tolerance Principles for Improved Airworthiness of Rotorcraft; February 2000, pp. 9 - 1 - 9 - 8; In English; See also 20000032859; Copyright Waived; Avail: CASI; A02, Hardcopy

This paper presents the work carried out by GKN Westland Helicopters in the damage tolerance evaluation of the EH101 airframe. A comprehensive programme of crack growth testing and analysis was undertaken and is described in this paper. A simplified analysis method was developed and used to predict flaw growth in the Main Load Path structure of the EH101. The analysis showed that high frequency vibratory loads exceed the crack growth threshold at relatively short crack lengths. This has been confirmed by a full-scale airframe crack growth test in which a 4mm crack was propagated under representative loading. These results have led to the adoption of the "Flaw Tolerant (Enhanced) Safe Life" approach for fatigue critical components on the EH101 airframe.

Author

Damage; Tolerances (Mechanics); Cracks; Crack Propagation; Eh-101 Helicopter; Fracturing

20000032960 Virginia Polytechnic Inst. and State Univ., Dept. of Aerospace and Ocean Engineering, Blacksburg, VA USA

Multidisciplinary Design Investigation of Truss-Braced Wing Aircraft, Phase 4 Final Report, 1 Jul. - 31 Oct. 1999

Grossman, B., Virginia Polytechnic Inst. and State Univ., USA; Kapania, R. K., Virginia Polytechnic Inst. and State Univ., USA; Mason, W. H., Virginia Polytechnic Inst. and State Univ., USA; Schetz, J. A., Virginia Polytechnic Inst. and State Univ., USA; April 2000; 48p; In English

Contract(s)/Grant(s): NAG1-2217; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The subject grant was in effect from 7/1/99 to 10/31/99. The objective of this grant was to complete a strut-braced wing study which began, which was in effect from 6/27/96 until 9/15/99. While the initial grant was on-going, we were also under subcontract to Lockheed-Martin, Aerospace Systems Division, Marietta, GA to do additional studies related to the strut-braced wing grant "A Structural and Aerodynamic Investigation of a Strut-Braced Wing Transonic Aircraft Concept", 4/1/98-11/15/98. Lockheed-Martin was under contract to NASA Langley. Finally the research under this grant has led to a joint proposal from NASA Langley, Lockheed-Martin, Virginia Tech and NASA Dryden to develop a transonic strut-braced wing demonstration aircraft in response to Flight Research for Revolutionary Aeronautical Concepts (REVCON). This final report summarizes the research done, augmented by the additional concomitant research projects mentioned above.

Derived from text

Trusses; Wings; Multidisciplinary Design Optimization; Aircraft Design; Supersonic Aircraft

20000032961 NASA Ames Research Center, Moffett Field, CA USA

Potential Flow Theory and Operation Guide for the Panel Code PMARC, Version 14

Ashby, Dale L., NASA Ames Research Center, USA; December 1999; 152p; In English

Contract(s)/Grant(s): RTOP 538-15-11

Report No.(s): NASA/TM-1999-209582; A-00V0005; NAS 1.15:209582; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

The theoretical basis for PMARC, a low-order panel code for modeling complex three-dimensional bodies, in potential flow, is outlined. PMARC can be run on a wide variety of computer platforms, including desktop machines, workstations, and supercomputers. Execution times for PMARC vary tremendously depending on the computer resources used, but typically range from several minutes for simple or moderately complex cases to several hours for very large complex cases. Several of the advanced features currently included in the code, such as internal flow modeling, boundary layer analysis, and time-dependent flow analysis, including problems involving relative motion, are discussed in some detail. The code is written in FORTRAN77, using adjustable-size arrays so that it can be easily redimensioned to match problem requirements and computer hardware constraints. An overview of the program input is presented. A detailed description of the input parameters is provided in the appendices. PMARC results for several test cases are presented along with analytic or experimental data, where available. The

input files for these test cases are given in the appendices. PMARC currently supports plotfile output formats for several commercially available graphics packages. The supported graphics packages are Plot3D, Tecplot, and PmarcViewer.

Author

Flow Theory; Panel Method (Fluid Dynamics); Applications Programs (Computers); Mathematical Models; Three Dimensional Bodies; Potential Flow

20000033169 NASA Langley Research Center, Hampton, VA USA

Yawed-Rolling Tire Mechanical Properties Testing of the Navy T-45 Aircraft Tires

Daugherty, Robert H., NASA Langley Research Center, USA; March 2000; 210p; In English

Contract(s)/Grant(s): RTOP 706-11-02

Report No.(s): NASA/TM-2000-209869; NAS 1.15:209869; L-17933; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

The T-45 Goshawk is a USA Navy Jet aircraft used primarily as a trainer. The aircraft design makes use of "off the shelf" hardware as much as possible and was found to have unusual directional control issues during around operations. The aircraft was involved in numerous pilot-induced-oscillation incidents as well as observed to have unusual directional control reactions to failed main gear tires, a condition that is normally handled relatively easily by conventional aircraft steering control techniques. The behavior of the aircraft's tires had previously been modeled in simulators as a result of approximations provided in 40-year-old reference publications. Since knowledge of the true tire cornering and braking behavior is essential to modeling, understanding, and fixing directional control problems, the USA Navy requested assistance from the NASA Langley Research Center's (LARC) Aircraft Landing Dynamics Facility (ALDF) to define the yawed-rolling mechanical properties of the T-45 aircraft tires. The purpose of this report is to document the results of testing the subject tires at the NASA LaRC ALDF in September 1998. Brief descriptions of the Instrumented Tire Test Vehicle (ITTV) are included to familiarize the reader with the ITTV capabilities, data acquisition system, test and measurement techniques, data accuracy, and analysis and presentation of the testing results.

Author

Aircraft Design; Aircraft Landing; Aircraft Tires; Control Systems Design; Data Acquisition; Mechanical Properties; Simulators

20000033217 NASA Langley Research Center, Hampton, VA USA

Overview of Conceptual Design of Early VentureStar(TM) Configurations

Lockwood, M. K., NASA Langley Research Center, USA; [2000]; 14p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2000-1042; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

One of NASA's goals is to enable commercial access to space at a cost of \$1000/lb (an order of magnitude less than today's cost) by approximately 2010. Based on results from the 1994 Congressionally mandated, NASA led, Access-to-Space Study, an all rocket-powered single-stage-to-orbit reusable launch vehicle was, selected as the best option for meeting the goal. To address the technology development issues and the follow-on development of an operational vehicle, NASA initiated the X-33 program. The focus of this paper is on the contributions made by the NASA Langley Research Center (LaRC), from 1997-1998, to the conceptual design of the Lockheed Martin Skunk Work's (LMSW) operational reusable single-stage-to-orbit VentureStar(sup TM) vehicle. The LaRC effort has been in direct support of LMSW and NASA Marshall Space Flight Center (MSFC). The primary objectives have been to reduce vehicle dry weight and improve flyability of the VentureStar(sup TM) concepts. This paper will briefly describe the analysis methods used and will present several of the concepts analyzed and design trades completed.

Author

Design Analysis; Venturestar Launch Vehicle; Commercial Spacecraft; X-33 Reusable Launch Vehicle

20000033438 NASA Dryden Flight Research Center, Edwards, CA USA

Hyper-X Model Testing with Animation

Mar. 21, 1996; In English; Videotape: 6 min. 25 sec. playing time, in color, with partial sound

Report No.(s): NONP-NASA-VT-2000043976; No Copyright; Avail: CASI; B01, Videotape-Beta; V01, Videotape-VHS

Live footage shows the Hyper-X program modeling at NASA Langley Research Center. The Hyper-X craft is shown on top of a Pegasus booster in a 20" Mach 6 Wind Tunnel. Visualization data runs are performed in the wind tunnel. Also seen is a brief interview with Vincent Rausch the Hyper-X Program Manager. Animation includes the flight model of the Hyper-X vehicle.

CASI

Hypersonic Flight; X-43 Vehicle; Pegasus Air-Launched Booster; Air Launching

20000033466 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Closely Supervised Reactive Control of an Uninhabited Aerial Vehicle
Glassco, Roy G.; Jan. 25, 2000; 141p; In English

Report No.(s): AD-A374174; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Currently, control of an uninhabited aerial vehicle (UAV) in flight is accomplished by manual control or a prior prescription of waypoints. The use of waypoints requires knowledge of vehicle position from either an Internal Navigation System (INS) or by using the Global Positioning System (GPS). This thesis proposes an alternative control method that incorporates some of the beneficial aspect of both fully manual and fully autonomous operation. Utilizing an on-board camera, an operator can control an uninhabited aerial vehicle by manually choosing desired targets of interest. The flight path of the uninhabited vehicle is determined autonomously from the camera gimbal angles. Specifically, the camera azimuth angle and elevation angle are transformed by an autopilot, providing commands to the aircraft. In this shared control operation, the operator of the payload (i.e. camera), has close supervision of the aircraft. The aircraft using an on-board computer is given autonomous control of aircraft flight, reducing personnel requirements. The aircraft controls the operations to alter flight path to reorient the aircraft to fly towards a target and at a specified range, loiter over the target. In the most basic mode of operation, the camera operator must manually track the target providing continuous updates to the camera angles. In an advanced mode of operation with the use of an INS or GPS, the aircraft autonomously determines the camera angles from a single locked target position that the operator specifies. The camera angles autonomously determined are referred to as virtual camera angles and are used to control the aircraft in the same manner as real camera angles. With the use of the virtual camera angles, the operator is free to look for other targets or perform other tasks. As an added safe mode, in the event of data transmission loss, the aircraft will fly straight and level in its current direction.

DTIC

Remotely Piloted Vehicles; Global Positioning System; Data Transmission; Manual Control; Inertial Navigation; Drone Vehicles

20000033472 Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA
Crew Systems Analysis of Unmanned Aerial Vehicle (UAV) Future Job and Tasking Environments

Barnes, Michael J.; Knapp, Beverly G.; Tillman, Barry W.; Walters, Brett A.; Velicki, Darlene; Jan. 2000; 57p; In English
Report No.(s): AD-A374230; ARL-TR-2081; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The purpose of the research project was to understand the future crew environments for developing unmanned aerial vehicle (UAV) systems. A variety of human engineering tools job assessment software system JASS, enhanced computer-aided testing ECAT, and MicroSaint(TM) were used to address crew issues related to the utility of having rated aviators as crew members, supplementing current crews with imagery and intelligence specialists, and the use of automation to improve systems efficiency. Data from 70 soldiers and experts from Fort Huachuca, Arizona, Fort Hood, Texas, and Hondo, Texas, were collected as part of this effort. The general finding was that the use of cognitive methods and computerized tool sets to understand future crew environments proved to be cost effective and useful. Specifically, no evidence was found to support a requirement for rated aviators in future Army missions, but the use of cognitively oriented embedded training simulators was suggested to aid novices in developing the cognitive skills evinced by experts. The efficacy of adding imagery specialists to 96U crews was discussed, and specific recommendations related to automation were derived from the workload modeling.

DTIC

Computer Techniques; Aircraft Pilots; Pilotless Aircraft; Workloads (Psychophysiology)

20000033622 Florida Univ., Dept. of Aerospace Engineering, Mechanics and Engineering Science, Gainesville, FL USA
Optimization of Aerospace Structure Subject to Damage Tolerance Criteria *Final Report*

Akgun, Mehmet A., Florida Univ., USA; [1999]; 3p; In English

Contract(s)/Grant(s): NCC1-268; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective of this cooperative agreement was to seek computationally efficient ways to optimize aerospace structures subject to damage tolerance criteria. Optimization was to involve sizing as well as topology optimization. The work was done in collaboration with Steve Scotti, Chauncey Wu and Joanne Walsh at the NASA Langley Research Center. Computation of constraint sensitivity is normally the most time-consuming step of an optimization procedure. The cooperative work first focused on this issue and implemented the adjoint method of sensitivity computation in an optimization code (runstream) written in Engineering Analysis Language (EAL). The method was implemented both for bar and plate elements including buckling sensitivity for the latter. Lumping of constraints was investigated as a means to reduce the computational cost. Adjoint sensitivity computation was developed and implemented for lumped stress and buckling constraints. Cost of the direct method and the adjoint method was compared for various structures with and without lumping. The results were reported in two papers. It is desirable to optimize topology of an aerospace structure subject to a large number of damage scenarios so that a damage tolerant structure is obtained. Including damage scenarios in the design procedure is critical in order to avoid large mass penalties at later stages.

A common method for topology optimization is that of compliance minimization which has not been used for damage tolerant design. In the present work, topology optimization is treated as a conventional problem aiming to minimize the weight subject to stress constraints. Multiple damage configurations (scenarios) are considered. Each configuration has its own structural stiffness matrix and, normally, requires factoring of the matrix and solution of the system of equations. Damage that is expected to be tolerated is local and represents a small change in the stiffness matrix compared to the baseline (undamaged) structure. The exact solution to a slightly modified set of equations can be obtained from the baseline solution economically without actually solving the modified system. Sherrnan-Morrison-Woodbury (SMW) formulas are matrix update formulas that allow this. SMW formulas were therefore used here to compute adjoint displacements for sensitivity computation and structural displacements in damaged configurations.

Derived from text

Aircraft Structures; Damage; Optimization; Computation; Aeronautical Engineering; Impact Tolerances

07

AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

20000027604 American Inst. of Aeronautics and Astronautics, New York, NY USA

Rolls-Royce Industrial Trent: Combustion and Other Technologies

Barkey, C.; Richards, S.; Harrop, N.; Kotsioprifitis, P.; Mastroberardino, R.; Jan. 1999; 8p; In English

Report No.(s): AD-A373340; ISABE-99-7285; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

In 1993, Rolls-Royce Gas Turbine Engines Canada Inc. (today an integral part of Rolls-Royce Canada) was launched to develop a dry low emissions (DLE) industrial derivative of the aero Trent engine. The aero Trent is now in service powering the Boeing 777 aircraft and the Airbus A330. The Trent 800 is certified at 90,000 lb. thrust and was the first engine in the world to be certified at that level. The industrial version builds on this pedigree and follows a long lineage of aero derivative industrial engines. It has the declared objectives to provide customers with 50MW of power, a life of 25,000 hours for all hot end parts and 50,000 hours on other components, and a thermal efficiency of 42 percent. to build on the experience of the Rolls-Royce RB211-DLE industrial engine, the selected combustor configuration for the 35:1 compression ratio engine was of a cannular design with 3 lean-premix stages in series (primary, secondary, and tertiary stages). The development program for natural gas operation is now at a stage where the main advantages of the 3 stage combustor and other technology features on the Trent can be documented.

DTIC

Aircraft Engines; Gas Turbines; Combustion Chambers

20000027680 Pratt and Whitney Aircraft, West Palm Beach, FL USA

Direct Fuel Cooled Composite Structure

Medwick, Denis G., Pratt and Whitney Aircraft, USA; Castro, Joaquin H., Pratt and Whitney Aircraft, USA; Sobel, David R., United Technologies Corp., USA; Boyet, Guy, Office National d'Etudes et de Recherches Aerospatiales, France; Vidal, Jean-Pierre, SNECMA, France; Jan. 1999; 6p; In English; Prepared in cooperation with United Technologies Research Center, East Hartford, CT., ONERA, Palaiseau, France, and SEP Div., of SNECMA, Saint-Medard-en-Jalles, France

Report No.(s): AD-A373274; ISABE-99-7284; No Copyright; Avail: CASI; A01, Microfiche; A02, Hardcopy

One of the more challenging aspects of hypersonic propulsion systems is the development of lightweight structure that can withstand the severe conditions associated with flight up to Mach 8. Currently, the Pratt & Whitney expendable scramjet engine concept utilizes a metallic combustor, based upon high temperature alloys with integral, endothermic fuel cooling. There is the potential for reduction in propulsion system weight and cost, and increase in thermal management margin if these high density metal alloys can be replaced with advanced composite materials. Pratt & Whitney (P&W) and ONERA (Office National d'Etudes et de Recherches Aerospatiales) are prime contractors in a joint U. S. Air Force (USAF) / French Directeur Generale d'Armements (DGA) sponsored advanced technology demonstration program that combines direct fuel cooling with a hot structure manufactured from advanced composite materials. The four-year Advanced Combustion Chamber Concepts (AC3) Program proposes to combine these two innovative technologies in two proof-of-concept demonstrations. P&W is supported in this program by the United Technologies Research Center (UTRC), and ONERA is supported by SEP (Societe d'Europeenne de

Propulsion) Division of SNECMA (Société Nationale d'Études et de Construction de Moteurs d'Aviation) Corporation. Phase 1 of AC3 will be a sector panel test, while Phase 2 is planned as a fabrication and test of a 2-D scramjet combustor.

DTIC

Composite Structures; Combustion Chambers; Liquid Cooling; Supersonic Combustion Ramjet Engines; Hypersonic Flight; Endothermic Fuels; Engine Design

20000027682 Defence Evaluation Research Agency, Farnborough, UK

Lifting and Life Extension of Fracture Critical Aeroengine Components

Boyd-Lee, A. D., Defence Evaluation Research Agency, UK; Harrison, G. F., Defence Evaluation Research Agency, UK; Painter, D., Defence Evaluation Research Agency, UK; Sep. 10, 1999; 11p; In English

Report No.(s): AD-A373285; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

Engine removal costs and the consequences of grounding aircraft are many times greater than the replacement component costs. The paper addresses several areas where DERA has been instrumental in generating procedures to enable more of the available safe service lives of fracture critical aeroengine components to be utilized. More effective methods for handling non-finite results (discontinued fatigue tests) are explored. General life extension via support of the

DTIC

Aircraft Engines; Engine Parts; Service Life; Fatigue Tests; Costs

20000028381 SRS Technologies, Huntsville, AL USA

Innovative Visual Modeling Environment for Turbine Engine Reverse Modeling Aid Program (TERMAP) Final Report, 28 Apr. 1999 - 28 Jan. 2000

Atkins, Leigh E.; DePlachett, Charles P.; Jan. 27, 2000; 19p; In English

Contract(s)/Grant(s): F33615-99-C-2929

Report No.(s): AD-A373135; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Report developed under SBIR contract for topic AF99-2O5. There is a need for an innovative Graphical User Interface (GUI), or Visual Modeling Environment, for the Turbine Engine Reverse Modeling Aid Program (TERMAP) which is used by DoD, NASA, and contractors for modeling gas turbine engine propulsion systems. The development of such a user-friendly, innovative GUI was undertaken during this Phase I by SRS Technologies. This Phase I SBIR contract has resulted: %in a user-friendly, Windows- based GUI which meets and exceeds the performance objectives. This report summarizes the Phase I results and software capabilities. Visual TERMAP can import existing TERMAP input files or create new engine cycle configurations using the drag and drop interface. Visual TERMAP automatically tracks station numbers and TERMAP's Parameter Index Codes (PICs). Compressor and turbine maps can be scaled and plotted. Visual TERMAP also performs trade studies and graphs results using an integrated graphing program. Software deliverables include the Visual TERMAP software program.

DTIC

Propulsion System Configurations; Propulsion System Performance; Gas Turbine Engines; Reverse Engineering

20000028395 Defence Evaluation Research Agency, Farnborough, UK

Hydrogen Peroxide Based Propulsion System for Micro Air Vehicle Applications

Cheung, W. S., Defence Evaluation Research Agency, UK; Tilston, J. R., Defence Evaluation Research Agency, UK; Sep. 10, 1999; 7p; In English

Report No.(s): AD-A373361; ISABE-99-7278; No Copyright; Avail: CASI; A01, Microfiche; A02, Hardcopy

The miniaturisation of sensors and weapon system will enable the development of micro air vehicles (MAVs) for use in military and surveillance operations, such as signal jamming and intelligence gathering. However, the propulsion systems for MAVs will need to have a range of engine characteristics to satisfy operating requirements. The Propulsion Department of DERA proposed a hydrogen peroxide (H₂O₂), hybrid rocket/turbine engine for micro air vehicle propulsion. A feasibility study was carried out on the proposed engine and compared against parameters set out in a preliminary specification. The study shows that a bipropellant system with on-board oxygen gives the best flight endurance. The engine configuration will consist of a convergent/divergent nozzle and a ducted fan. This engine can largely meet the physical requirements. It can also meet the indoor and urban reconnaissance requirement of 1-hour flight endurance. The H₂O₂ engine compares favorably with a rival engine (micro gas turbine). However, the hydrogen peroxide system has an important advantage that it is an established technology and carries considerably less technical risk.

DTIC

Gas Turbines; Hydrogen Peroxide; Liquid Rocket Propellants; Propulsion System Configurations; Miniaturization

20000030660 Technion - Israel Inst. of Tech., Faculty of Aerospace Engineering, Haifa Israel

Solid Fuel Ramjet Regulation by Means of an Air Division Valve

Pelosi-Pinhas, Deborah, Technion - Israel Inst. of Tech., Israel; Gany, Alon, Technion - Israel Inst. of Tech., Israel; Jan. 1999; 8p; In English

Report No.(s): AD-A373397; ISABE-99-7245; No Copyright; Avail: CASI; A01, Microfiche; A02, Hardcopy

An analytical study was conducted, developing a theoretical model for the regulation of solid fuel ramjets by means of an air division valve. The solid fuel ramjet motor is the simplest air-breathing propulsion means for supersonic flights. However, the variable flight conditions over the operating envelope of altitudes and velocities significantly affect the motor performance. Regulation requirement was defined in this study as the motor capability of operating at a constant, desirable fuel to air ratio over a wide range of flight conditions. The adopted method is based on an air division valve, which drives a part of the incoming air from the diffuser through a bypass to the aft-mixing end of the combustion chamber. The model takes into account the parameters that influence the burning rate of the solid fuel (air mass flow, port diameter) and formulates a general regulation law for the division valve. The method was checked for specific cases, considering different trajectories. The control law provided a good regulation by means of the division valve, determining the instantaneous opening state of the valve that assures a constant optimal fuel to air ratio over the operating envelope.

DTIC

Air Breathing Engines; Ramjet Engines; Burning Rate; Flight Conditions; Solid Propellants

20000031333 Air Force Research Lab., Propulsion Directorate, Wright-Patterson AFB, OH USA

Control of Flow Separation on a Turbine Blade by Utilizing Tail Extensions *Final Report, 4 Sep. 1997-15 Mar. 1999*

Murawski, C. G.; Sep. 1999; 40p; In English

Contract(s)/Grant(s): Proj-3066

Report No.(s): AD-A373507; AFRL-PR-WP-TR-1999-2100; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An experimental study was conducted in a two-dimensional linear cascade, focusing on the suction surface of a low pressure turbine blade. Flow Reynolds numbers, based on exit velocity and suction surface length were varied from 50,000 to 300,000. The axial chord of the blades was varied using tail extenders from 0% to 15% beyond design. The effects of Reynolds number on a low pressure turbine cascade blade with tail extensions was investigated. This study has shown that for certain cases, changing the axial chord of a low pressure turbine blade by utilizing tail extensions provided a clear improvement in boundary layer behavior which results in better overall performance. There was no additional advantage when the tail extensions were longer than 6.1% of the axial chord. The shortest tail extension resulted in the greatest zone of performance enhancement. The longer tail extension resulted in a smaller region of performance enhancement.

DTIC

Gas Turbines; Tail Assemblies; Turbulent Flow; Turbine Blades; Boundary Layer Separation; Separated Flow

20000031737 Taitech, Inc., Beavercreek, OH USA

Advanced Airbreathing Hydrocarbon-Fueled Aero-Engine Concepts *Final Report, May 1996-Jul 1998*

Streby, G. D.; Mathur, T.; Chen, T. H.; Eakins, W.; Jul. 1999; 89p; In English

Contract(s)/Grant(s): F33615-96-C-2670; AF Proj. 1025

Report No.(s): AD-A372847; AFRL-PR-WP-TR-1999-2038; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

An advanced long duration, high enthalpy direct connect water cooled supersonic combustion research facility has been designed and manufactured; initial calibrations have been performed. This facility provides the AFRL/PRS division with in house capability to conduct long duration scramjet combustor research and development. Simulations of flight Mach numbers to 7+ at flight dynamic pressures to 2000 psf are achievable using four separate facility nozzles ($M=1.8, 2.2, 2.6$, and 3.0). These efforts are directed at developing advanced propulsion systems for future Air Force high speed flight vehicles. In less than twenty four months, concepts and ideas for a scramjet test facility were analyzed and developed, and components were designed, fabricated, and installed to build an operational scramjet test facility. Components were assembled in Test Cell 22 at AFRL Bldg. 18E. The majority of the components (vitiator, inlet transition, facility nozzle, isolator sections, and fixed and traversing probes) are water cooled. The combustor test section provides a wide parametric space for evaluating fuel injection and flameholding concepts. The AFRL/PRSS Scramjet Test Facility is fully operational and a series of preliminary calibration tests have been completed to fully document the flow characteristics at the combustor inlet for a wide range of flight Mach numbers and dynamic pressures. Data from these tests are presented herein.

DTIC

Supersonic Combustion Ramjet Engines; Hypersonic Aircraft; Air Breathing Engines; Aerospace Vehicles

20000031779 Federal Data Corp., Hampton, VA USA

Fuel Plume Image Mixing Analysis Formulation With Proper Treatment of Non-Constant Velocity Flowfields

Mekkes, Gregory L., Federal Data Corp., USA; March 2000; 15p; In English

Contract(s)/Grant(s): NAS1-96013; RTOP 706-51-21-10

Report No.(s): NASA/CR-2000-209868; NAS 1.26:209868; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A previously developed technique allows an estimate of integral mixing to be obtained from an image of laser scattered light from particle seeded fuel in the hypervelocity flow through a scramjet combustor. This previous mixing analysis formulation contains an assumption of a constant velocity flowfield across the plane of the fuel plume image. For high-speed scramjet combustors, the velocity flowfield is quite uniform and an assumption of constant velocity works well. Applying this same mixing analysis technique to fuel plume images obtained from a mid-speed scramjet combustor makes it desirable to remove the constant velocity assumption. This is due to the non-uniform velocity flowfields present in mid-speed scramjet combustors. A new formulation of the mixing analysis methodology is developed and presented so that the technique can be applied to a mid-speed scramjet combustor without the need to assume a constant velocity flowfield.

Author

Fuel Flow; Plumes; Mixing; Velocity Distribution; Supersonic Combustion Ramjet Engines; Image Processing; Formulations

20000031884 American Inst. of Aeronautics and Astronautics, New York, NY USA

The Diagnostics and the Fault Detection of Gas Turbine Engines by Using Different Neural Networks

Torella, Giovanni; Torella, Roberto; Sep. 10, 1999; 10p; In English

Report No.(s): AD-A373338; ISABE-99-7282; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This paper deals with the results of a research carried out for the evaluation of Neural Networks for engine diagnostics. The study continues the works made in the past on the same subject. Now the main aim is to find new methods for improving the effectiveness of Neural Nets. The results presented here concern with two different Neural Nets: the Back Propagation Neural Networks (BPNN) and the Adaptive Resonance Theory Neural Networks (ART1-2). As regarding BPNN particular attention is paid to the improvement of training time and their robustness. The study of ART1-2 considers the use and the insertion of the probability of fault happening in the training patterns. The paper shows in full details all activities carried out as well as all improvements with respect to past results.

DTIC

Neural Nets; Robustness (Mathematics); Gas Turbine Engines

20000031895 Defence Science and Technology Organisation, Airframes and Engines Div., Melbourne Australia

Preliminary Finite Element Analysis of a Compressor Disk in the TF30 Engine

Faragher, J. S.; Antoniou, R. A.; Jan. 2000; 49p; In English

Contract(s)/Grant(s): Proj-

Report No.(s): AD-A373490; DSTO-TR-0915; DODA-AR-011-166; Copyright; Avail: Defense Technical Information Center (DTIC)

AMRL has been developing expertise in finite element analysis (PEA) of engine components, particularly compressor and turbine discs. The fourth stage Low Pressure Compressor (LPC) disc of the TF30 engine in the F-111 aircraft was chosen as the first component for detailed analysis after being identified as a prime candidate for the retirement-for-cause lifting methodology. This report describes a preliminary study of the stresses in this component. Two benchmark examples which show close agreement between PEA stress results and analytical solutions are presented. The PEA results confirm the critical location for low cycle fatigue failure specified by the OEM. The assembly loads are shown to significantly increase the mean and peak stresses but not the cyclic stress range. The thermal stresses are shown to be an order of magnitude smaller than the stresses caused by the rotation of the disc. The analysis shows that the most severe stresses produced in the disc under typical engine operating conditions are much lower than the yield stress of the disc material (Ti-8-I-I), which suggests a very conservative design. Recommendations are made for developing models that will more realistically represent the loads on the disc and the interaction with other components in order to determine whether the design is really as conservative as the current analysis suggests.

DTIC

Finite Element Method; Compressors

20000032747 NASA Glenn Research Center, Cleveland, OH USA

Performance and Durability of High Temperature Foil Air Bearings for Oil-Free Turbomachinery

DellaCorte, C., NASA Glenn Research Center, USA; Lukaszewicz, V., Akima Corp., USA; Valco, M. J., Army Research Lab., USA; Radil, K. C., Army Research Lab., USA; Heshmat, H., Mohawk Innovative Technology, Inc., USA; March 2000; 20p; In

English, 7-11 May 2000, Nashville, TN, USA; Sponsored by Society of Tribologists and Lubrication Engineers, USA

Contract(s)/Grant(s): RTOP 523-18-13

Report No.(s): NASA/TM-2000-209187/REV1; NAS 1.15:209187/REV1; ARL-TR-2202; E-11697-1/REV1; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The performance and durability of advanced, high temperature foil air bearings are evaluated under a wide range (10-50 kPa) of loads at temperatures from 25 to 650 C. The bearings are made from uncoated nickel based superalloy foils. The foil surface experiences sliding contact with the shaft during initial start/stop operation. To reduce friction and wear, the solid lubricant coating, PS304, is applied to the shaft by plasma spraying. PS304 is a NiCr based Cr₂O₃ coating with silver and barium fluoride/calcium fluoride solid lubricant additions. The results show that the bearings provide lives well in excess of 30,000 cycles under all of the conditions tested. Several bearings exhibited lives in excess of 100,000 cycles. Wear is a linear function of the bearing load. The excellent performance measured in this study suggests that these bearings and the PS304 coating are well suited for advanced high temperature, oil-free turbomachinery applications.

Author

Durability; High Temperature; Foil Bearings; Turbomachinery; Lubrication; Friction Reduction

20000032786 NASA Marshall Space Flight Center, Huntsville, AL USA

Thermodynamic Cycle Analysis of Magnetohydrodynamic-Bypass Airbreathing Hypersonic Engines

Litchford, Ron J., NASA Marshall Space Flight Center, USA; Bityurin, Valentine A., Academy of Sciences (USSR), USSR; Lineberry, John T., LyTec, Inc., USA; Aug. 02, 1999; 17p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Established analyses of conventional ramjet/scramjet performance characteristics indicate that a considerable decrease in efficiency can be expected at off-design flight conditions. This can be explained, in large part, by the deterioration of intake mass flow and limited inlet compression at low flight speeds and by the onset of thrust degradation effects associated with increased burner entry temperature at high flight speeds. In combination, these effects tend to impose lower and upper Mach number limits for practical flight. It has been noted, however, that Magnetohydrodynamic (MHD) energy management techniques represent a possible means for extending the flight Mach number envelope of conventional engines. By transferring enthalpy between different stages of the engine cycle, it appears that the onset of thrust degradation may be delayed to higher flight speeds. Obviously, the introduction of additional process inefficiencies is inevitable with this approach, but it is believed that these losses are more than compensated through optimization of the combustion process. The fundamental idea is to use MHD energy conversion processes to extract and bypass a portion of the intake kinetic energy around the burner. We refer to this general class of propulsion system as an MHD-bypass engine. In this paper, we quantitatively assess the performance potential and scientific feasibility of MHD-bypass airbreathing hypersonic engines using ideal gasdynamics and fundamental thermodynamic principles. Derived from text

Bypasses; Hypersonics; Magnetohydrodynamics; Air Breathing Engines; Thermodynamic Cycles

20000032789 NASA Marshall Space Flight Center, Huntsville, AL USA

Engine System Loads Development for the Fastrac 60K Flight Engine

Fraday, Greg, Sverdrup Technology, Inc., USA; Christensen, Eric R., Sverdrup Technology, Inc., USA; Mims, Katherine, NASA Marshall Space Flight Center, USA; Harris, Don, NASA Marshall Space Flight Center, USA; Parks, Russell, NASA Marshall Space Flight Center, USA; Brunty, Joseph, NASA Marshall Space Flight Center, USA; [2000]; 12p; In English; 41st; 41st Structures, Structural Dynamic and Materials Conference, 4-6 Apr. 2000, Atlanta, GA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 00-XXXX; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Early implementation of structural dynamics finite element analyses for calculation of design loads is considered common design practice for high volume manufacturing industries such as automotive and aeronautical industries. However, with the rarity of rocket engine development programs starts, these tools are relatively new to the design of rocket engines. In the new Fastrac engine program, the focus has been to reduce the cost to weight ratio; current structural dynamics analysis practices were tailored in order to meet both production and structural design goals. Perturbation of rocket engine design parameters resulted in a number of Fastrac load cycles necessary to characterize the impact due to mass and stiffness changes. Evolution of loads and load extraction methodologies, parametric considerations and a discussion of load path sensitivities are discussed.

Author

X-34 Reusable Launch Vehicle; Loads (Forces); Rocket Engine Design; Dynamic Structural Analysis

20000032862 Air Force Research Lab., Materials and Manufacturing Directorate, Wright-Patterson AFB, OH USA

Material Allowables for High Cycle Fatigue in Gas Turbine Engines

Nicholas, T., Air Force Research Lab., USA; Application of Damage Tolerance Principles for Improved Airworthiness of Rotorcraft; February 2000, pp. 4 - 1 - 4 - 9; In English; See also 20000032859; Copyright Waived; Avail: CASI; A02, Hardcopy

HCF failures in materials used in both static and rotating components of gas turbine engines have often been found to be attributable to fatigue loading on materials which have sustained some type of damage. Damage can be present from initial material or manufacturing defects, or can develop during service operation. In-service damage, while not catastrophic by itself, can degrade the HCF resistance of the material below that for which it was designed. Three major sources of in-service damage which can alter the HCF capability individually or in conjunction with one another are low cycle fatigue (LCF), foreign object damage (FOD), and contact fatigue. Other types of damage include creep, corrosion and thermal fatigue. The present design methodology is highly empirical and relies heavily on service experience to establish material allowable knockdown factors for each type of damage. To reduce HCF failures, the U.S. Air Force is developing a damage tolerant approach which addresses these issues in a less empirical manner. The effects of damage on HCF capability and a discussion of the material allowables under HCF are presented.

Author

Gas Turbine Engines; Damage; Structural Analysis; Systems Health Monitoring; Fatigue Tests; Structural Failure; Fatigue (Materials); Metals

08

AIRCRAFT STABILITY AND CONTROL

Includes flight dynamics, aircraft handling qualities; piloting; flight controls; and autopilots.

20000027418 Federal Aviation Administration, ACO Flight Test Branch, Seattle, WA USA

Certification of Spin Resistant Aircraft

Arnold, Eugene, Federal Aviation Administration, USA; 1999 Report to the Aerospace Profession: Forty Third Symposium Proceedings; September 1999, pp. 58-78; In English; See also 20000027414; Copyright; Avail: Issuing Activity

Research by NASA & FAA during the 1980's identified promising ways to improve spin resistance of light airplanes through enhanced wing leading edge design modifications. Certification Standards were subsequently developed and implemented for Spin Resistant aircraft via FAA NPRM Notice 89-5 (Mar 6, 1989) and FAR Part 23 Amendment 23-42 (Jan 3, 1991). The purpose was to reduce the number of general aviation stall/spin accidents, particularly at low altitude. Development of Spin Resistance Certification Criteria was initiated after a GAMA General Aviation Stall/Spin Workshop in Oct 1981. The Development of Spin Resistant Criteria was promoted by results of NASA Flight Tests on three typical single engine aircraft (AA-1X, C-23A, & PA-28RX). Several SAE and AIAA papers during the 1980's addressed "Spin Resistance", the NASA Spin Resistance tests, and "Development of Spin Resistance Criteria for Light General Aviation Aircraft". Initial TC Applications for certification as "Spin Resistant" were submitted for the Devore Sunbird (Hi Wing Single Engine Pusher/No Canard) and the OMAC Laser 300 (Turboprop Pusher Canard). For unrelated reasons, neither aircraft received full certification. Until recently, the JETCRUZER (Single Engine Turboprop Pusher Canard) was the only SE Aircraft to receive "Spin Resistant" certification, although with numerous limitations. Within the past two years, both the Cirrus SR-20 and Lancair Columbia 300 sought some form of Spin Resistant certification. Both received full certification in the fall of 1998, however neither was certified as fully spin resistant. Spin resistance certification testing is presently not addressed in AC 23-8A (Part 23 Flight Test Guide) and only briefly discussed in AC 23-15 (Small Aircraft Certification Compliance Program). Draft "Spin Resistant Testing" advisory material has been written, but not formally adopted. Additionally, Spin Resistance is presently a disharmony between FAR/JAR Part 23. During Lancair LC-40 certification tests, issues were identified regarding spin resistance, present FAR 23 spin resistant criteria, and interpretation of the FAR Part 23 spin resistant criteria. This presentation will discuss the evolution of "spin resistance" certification criteria, issues regarding "spin resistance" certification criteria, and "spin resistance" certification issues that came up during the Lancair LC-40 certification program.

Author

Certification; Aircraft Spin; Aerodynamic Stalling; Spin Dynamics; Spin Tests; Aircraft Accidents; Flight Tests; Leading Edges; Wings

20000032102 Georgia Inst. of Tech., School of Aerospace Engineering, Atlanta, GA USA

Development of An Intelligent Flight Propulsion Control System *Final Report, 1 Sep. 1998 - 31 Aug. 1999*

Calise, A. J., Georgia Inst. of Tech., USA; Rysdyk, R. T., Georgia Inst. of Tech., USA; Leonhardt, B. K., Georgia Inst. of Tech.,

USA; Oct. 01, 1999; 65p; In English

Contract(s)/Grant(s): NAG2-1174; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The initial design and demonstration of an Intelligent Flight Propulsion and Control System (IFPCS) is documented. The design is based on the implementation of a nonlinear adaptive flight control architecture. This initial design of the IFPCS enhances flight safety by using propulsion sources to provide redundancy in flight control. The IFPCS enhances the conventional gain scheduled approach in significant ways: (1) The IFPCS provides a back up flight control system that results in consistent responses over a wide range of unanticipated failures. (2) The IFPCS is applicable to a variety of aircraft models without redesign and, (3) significantly reduces the laborious research and design necessary in a gain scheduled approach. The control augmentation is detailed within an approximate Input-Output Linearization setting. The availability of propulsion only provides two control inputs, symmetric and differential thrust. Earlier Propulsion Control Augmentation (PCA) work performed by NASA provided for a trajectory controller with pilot command input of glidepath and heading. This work is aimed at demonstrating the flexibility of the IFPCS in providing consistency in flying qualities under a variety of failure scenarios. This report documents the initial design phase where propulsion only is used. Results confirm that the engine dynamics and associated hard nonlinearities result in poor handling qualities at best. However, as demonstrated in simulation, the IFPCS is capable of results similar to the gain scheduled designs of the NASA PCA work. The IFPCS design uses crude estimates of aircraft behaviour. The adaptive control architecture demonstrates robust stability and provides robust performance. In this work, robust stability means that all states, errors, and adaptive parameters remain bounded under a wide class of uncertainties and input and output disturbances. Robust performance is measured in the quality of the tracking. The results demonstrate the flexibility of the IFPCS architecture and the ability to provide robust performance under a broad range of uncertainty. Robust stability is proved using Lyapunov like analysis. Future development of the IFPCS will include integration of conventional control surfaces with the use of propulsion augmentation, and utilization of available lift and drag devices, to demonstrate adaptive control capability under a greater variety of failure scenarios. Further work will specifically address the effects of actuator saturation.

Author

Adaptive Control; Control Systems Design; Flight Control; Simulation; Propulsion System Performance; Propulsion System Configurations; Aircraft Control; Flight Simulation

20000033626 NASA Langley Research Center, Hampton, VA USA

Active Control by Conservation of Energy Concept

Maestrello, Lucio, NASA Langley Research Center, USA; [2000]; 11p; In English; 6th; 6th Aeroacoustics Conference, 12-14 Jun. 2000, Lahaina, HI, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2000-2045; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Three unrelated experiments are discussed; each was extremely sensitive to initial conditions. The initial conditions are the beginnings of the origins of the information that nonlinearity displays. Initial conditions make the phenomenon unstable and unpredictable. With the knowledge of the initial conditions, active control requires far less power than that present in the system response. The first experiment is on the control of shocks from an axisymmetric supersonic jet; the second, control of a nonlinear panel response forced by turbulent boundary layer and sound; the third, control of subharmonic and harmonics of a panel forced by sound. In all three experiments, control is achieved by redistribution of periodic energy response such that the energy is nearly preserved from a previous uncontrolled state. This type of active control improves the performance of the system being controlled.

Author

Active Control; Energy Conservation

09

RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, runways, hangars, and aircraft repair and overhaul facilities; wind tunnels, water tunnels, and shock tubes; flight simulators; and aircraft engine test stands. Also includes airport ground equipment and systems.

20000029574 NASA Langley Research Center, Hampton, VA USA

National Transonic Facility Characterization Status

Bobbitt, C., Jr., NASA Langley Research Center, USA; Everhart, J., NASA Langley Research Center, USA; Foster, J., NASA Langley Research Center, USA; Hill, J., NASA Langley Research Center, USA; McHatton, R., NASA Langley Research Center, USA; Tomek, W., NASA Langley Research Center, USA; [2000]; 34p; In English; 38th; 38th Aerospace Sciences Meeting and Exhibit, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2000-0293; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper describes the current status of the characterization of the National Transonic Facility. The background and strategy for the tunnel characterization, as well as the current status of the four main areas of the characterization (tunnel calibration, flow quality characterization, data quality assurance, and support of the implementation of wall interference corrections) are presented. The target accuracy requirements for tunnel characterization measurements are given, followed by a comparison of the measured tunnel flow quality to these requirements based on current available information. The paper concludes with a summary of which requirements are being met, what areas need improvement, and what additional information is required in follow-on characterization studies.

Author

Transonic Wind Tunnels; Characterization

20000031969 Federal Aviation Administration, Office of Communications, Navigation and Surveillance Systems, Washington, DC USA

FAA Heliport/Vertiport Lighting Conference: Proceedings *Final Report*

Smith, R. D., Federal Aviation Administration, USA; Nov. 1999; 276p; In English

Report No.(s): PB2000-101746; DOT/FAA/ND-99/1; No Copyright; Avail: CASI; A03, Microfiche; A13, Hardcopy

As the Vertical Flight Industry moves into instrument flight rules (IFR) operations at heliports, it has become apparent to both FAA and the users that there is research and development to be done on heliport lighting. With the civil tiltrotor now in production at Bell Helicopter, there is also work to be done on vertiport lighting. In looking at the heliport lighting research done by the FAA over the last decade and the resulting advisory circular guidance, it is clear that there are many more questions than answers. To answer these questions would require much more in the way of resources than what is likely to be available in the near future. With this in mind, the FAA sought the advice of the aviation community on how best to proceed with the limited available resources.

NTIS

Heliports; Lighting Equipment; Landing Aids

20000031970 Texas A&M Univ., Texas Transportation Inst., College Station, TX USA

Update: Implementation of the Micropaver Pavement Management System on TXDOT Aviation Division Airfields (Revised) *Interim Report, 1 Sep. 1998 - 31 Aug. 1999*

Freeman, T., Texas A&M Univ., USA; Dresser, G. B., Texas A&M Univ., USA; Apr. 1999; 98p; In English

Contract(s)/Grant(s): Proj. 7-1913

Report No.(s): PB2000-101736; Rept-1913-2; No Copyright; Avail: CASI; A02, Microfiche; A05, Hardcopy

This report describes the status of MicroPAVER implementation at the airports included in the Texas Aeronautical Facilities Plan. In 1998, the research team inspected 41 airports with 56 runways, 54 primary aprons, and 62 primary taxiways. To date, 245 airports have been inspected and the resulting information entered into the MicroPAVER database. For this report, the aprons and taxiways were inspected, but the data was not entered. The list of airports is included in Table 1. The runways at all 245 airports have been inspected and the resulting information entered into the MicroPAVER database. Aprons and taxiways have been inspected at nearly 80 of these airports.

NTIS

Runways; Pavements; Airports

10

ASTRONAUTICS (GENERAL)

Includes general research topics related to space flight and manned and unmanned space vehicles, platforms or objects launched into, or assembled in, outer space; and related components and equipment. Also includes manufacturing and maintenance of such vehicles or platforms.

20000029570 Macready (John A.), Mariposa, CA USA

First Steps into Space

Liston, Sally Macready, Liston (Sally Macready), USA; [1970]; In English; 7th; 7th Annual Meeting and Technical Display, 19-22 Oct. 1970, Houston, TX, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 70-1255; No Copyright; Avail: Issuing Activity, Hardcopy

This paper presents the First Steps Into Space. It discusses hazards such as lack of pressure, lack of oxygen, and intense cold associated with high altitude flying in the early years of 1920.

CASI

Flight Hazards; Supersonic Flight; Aerospace Environments

20000032783 NASA Johnson Space Center, Houston, TX USA

New Mission Control Center Briefing

May 16, 1995; In English; Videotape: 58 min. playing time, in color, with sound

Report No.(s): NONP-NASA-VT-2000039783; No Copyright; Avail: CASI; B03, Videotape-Beta; V03, Videotape-VHS

Live footage shows panelists, Chief Center Systems Division John Muratore, and Acting Chief, Control Center Systems Division, Linda Uljon, giving an overview of the new Mission Control Center. Muratore and Uljon talk about the changes and modernization of the new Center. The panelists mention all the new capabilities of the new Center. They emphasize the Distributed real time command and control environment, the reduction in operation costs, and even the change from coaxial cables to fiber optic cables. Uljon also tells us that the new Control Center will experience its first mission after the launch of STS-70 and its first complete mission (both launching and landing) during STS-71.

CASI

Command and Control; Ground Based Control; Flight Control; Ground Operational Support System; Control Systems Design; Systems Integration

20000030654 Old Dominion Univ., Engineering Management Dept., Norfolk, VA USA

Development of Response Surface Models for Rapid Analysis & Multidisciplinary Optimization of Launch Vehicle Design Concepts *Final Report*

Unal, Resit, Old Dominion Univ., USA; [1999]; 53p; In English

Contract(s)/Grant(s): NAG1-2157

Report No.(s): ODURF-192121; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Multidisciplinary design optimization (MDO) is an important step in the design and evaluation of launch vehicles, since it has a significant impact on performance and lifecycle cost. The objective in MDO is to search the design space to determine the values of design parameters that optimize the performance characteristics subject to system constraints. Vehicle Analysis Branch (VAB) at NASA Langley Research Center has computerized analysis tools in many of the disciplines required for the design and analysis of launch vehicles. Vehicle performance characteristics can be determined by the use of these computerized analysis tools. The next step is to optimize the system performance characteristics subject to multidisciplinary constraints. However, most of the complex sizing and performance evaluation codes used for launch vehicle design are stand-alone tools, operated by disciplinary experts. They are, in general, difficult to integrate and use directly for MDO. An alternative has been to utilize response surface methodology (RSM) to obtain polynomial models that approximate the functional relationships between performance characteristics and design variables. These approximation models, called response surface models, are then used to integrate the disciplines using mathematical programming methods for efficient system level design analysis, MDO and fast sensitivity simulations. A second-order response surface model of the form given has been commonly used in RSM since in many cases it can provide an adequate approximation especially if the region of interest is sufficiently limited.

Author

Multidisciplinary Design Optimization; Launch Vehicles; Mathematical Models; Aircraft Design; Design Analysis

20000031396 Wyoming Univ., Coll. of Engineering, Laramie, WY USA

Reduction of Base Drag on Launch Vehicles *Final Report, Mar. - Nov. 1999*

Naughton, Jonathan, Wyoming Univ., USA; [1999]; 11p; In English; Original contains color illustrations

Contract(s)/Grant(s): NAG4-167

Report No.(s): UWAL-2000-01; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes the work accomplished during a first-year investigation of base drag reduction for launch vehicles. Interest in this work has arisen due to the large base areas associated with the current generation of launch vehicles. For example, the X-33 and Venture Star configurations all have large base areas because of the aero-spike engines they use. Because of the large base-to-wetted area ratios of these vehicles, the majority of the vehicle drag is due to base drag. Based on previous research, there appears to be a means for reducing the base drag on such vehicles. A clear relationship between viscous fore-body drag and base drag was demonstrated. For subsonic flow conditions, an increase in fore-body drag causes a decrease in base drag. This base-drag reduction is a result of boundary layer effects at the base of the vehicle. The shear layer that develops from the boundary layer separating at the back of the vehicle is the conduit through which momentum is transferred from the high energy free-stream flow

to the low-energy fluid in the base area. One way to think of the base drag is that it is the momentum required to accelerate this low-energy fluid. The boundary layer that develops on the fore body acts as an "insulator" between the external flow and the low-energy air at the base. As the viscous fore-body drag is increased, the boundary layer thickness at the aft end of the fore body increases, thereby reducing the rate at which momentum is transferred to the base area. As a result of the lower momentum transfer (or reduced pumping), the base pressure coefficient rises resulting in a reduction of base drag.

Derived from text

Aerodynamic Drag; Drag Reduction; Launch Vehicles; Aircraft Engines; Base Pressure

~~200000~~32921 NASA Langley Research Center, Hampton, VA USA

An Entry Flight Controls Analysis for a Reusable Launch Vehicle

Calhoun, Philip, NASA Langley Research Center, USA; [2000]; 14p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2000-1046; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

The NASA Langley Research Center has been performing studies to address the feasibility of various single-stage to orbit concepts for use by NASA and the commercial launch industry to provide a lower cost access to space. Some work on the conceptual design of a typical lifting body concept vehicle, designated VentureStar(sup TM) has been conducted in cooperation with the Lockheed Martin Skunk Works. This paper will address the results of a preliminary flight controls assessment of this vehicle concept during the atmospheric entry phase of flight. The work includes control analysis from hypersonic flight at the atmospheric entry through supersonic speeds to final approach and landing at subsonic conditions. The requirements of the flight control effectors are determined over the full range of entry vehicle Mach number conditions. The analysis was performed for a typical maximum crossrange entry trajectory utilizing angle of attack to limit entry heating and providing for energy management, and bank angle to modulation of the lift vector to provide downrange and crossrange capability to fly the vehicle to a specified landing site. Sensitivity of the vehicle open and closed loop characteristics to CG location, control surface mixing strategy and wind gusts are included in the results. An alternative control surface mixing strategy utilizing a reverse aileron technique demonstrated a significant reduction in RCS torque and fuel required to perform bank maneuvers during entry. The results of the control analysis revealed challenges for an early vehicle configuration in the areas of hypersonic pitch trim and subsonic longitudinal controllability.

Author

Spacecraft Reentry; Lifting Reentry Vehicles; Recoverable Spacecraft; Feedback Control; Flight Control; Controllability

~~200000~~32978 NASA Marshall Space Flight Center, Huntsville, AL USA

An Innovative Structural Mode Selection Methodology: Application for the X-33 Launch Vehicle Finite Element Model

Hidalgo, Homero, Jr., American Inst. of Aeronautics and Astronautics, USA; [2000]; 9p; In English, 3-6 Apr. 2000, Atlanta, GA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2000-1587; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

An innovative methodology for determining structural target mode selection and mode selection based on a specific criterion is presented. An effective approach to single out modes which interact with specific locations on a structure has been developed for the X-33 Launch Vehicle Finite Element Model (FEM). We presented Root-Sum-Square (RSS) displacement method computes resultant modal displacement for each mode at selected degrees of freedom (DOF) and sorts to locate modes with highest values. This method was used to determine modes, which most influenced specific locations/points on the X-33 flight vehicle such as avionics control components, aero-surface control actuators, propellant valve and engine points for use in flight control stability analysis and for flight POGO stability analysis. Additionally, the modal RSS method allows for primary or global target vehicle modes to also be identified in an accurate and efficient manner.

Author

Aerodynamic Stability; Finite Element Method; Mathematical Models; Stability Tests; X-33 Reusable Launch Vehicle

~~200000~~33619 NASA Marshall Space Flight Center, Huntsville, AL USA

We Must Take the Next Steps Towards Safe, Routine Space Travel

Lyles, G. M., NASA Marshall Space Flight Center, USA; [2000]; 30p; In English; 2000 National Space and Missile Materials Symposium, 28 Feb. 2000, San Diego, CA, USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents, in viewgraph form, six in a half generations of airplanes in a century. Some of the topics include: 1) Enterprise goals; 2) Generations of Reusable Launch Vehicles; 3) Space Transportation Across NASA; 4) Three Tiered Implementation Approach for Future Space Transportation Technology; 5) Develop a Comprehensive, Agency Level Space Transportation Plan That Will Enable NASA's Strategic Plan; 6) Timeline for Addressing NASA's Needs; 7) Significant 2nd

Generation Technology Drivers; 8) Example Large Scale Ground Demonstrations; and 9) Example Pathfinder Demonstrations. The paper also includes various aircraft designs and propulsion system technology.

CASI

Space Transportation; Aircraft Design; Reusable Launch Vehicles; Technology Utilization

20000027607 NASA Kennedy Space Center, Cocoa Beach, FL USA

STS-99 Post-Launch Press Conference

Feb. 11, 2000; In English; Videotape: 33 min. 5 sec. playing time, in color, with sound

Report No.(s): NONP-NASA-VT-2000025578; No Copyright; Avail: CASI; B03, Videotape-Beta; V03, Videotape-VHS

Live footage shows the participants in the Post-Launch Press Conference disclosing the status of the STS-99 flight. The panelists consist of Bill Gerstenmaier, Acting Manager of Launch Integration and Dave King, Director of Shuttle Operations at KSC (Kennedy Space Center). Joel Wells, of NASA's Public Affairs Office, introduces each panelist as they discuss the mapping to the Earth, and improve safety of the shuttle. The panelists also answer questions from the audience about the countdown. Also shown are various shots of the Shuttle on the launch pad.

CASI

Spacecraft Launching; Postlaunch Reports; Conferences; Shuttle Imaging Radar; Radar Imagery; Topography; Earth Surface; Flight Safety

20000028407 NASA Kennedy Space Center, Cocoa Beach, FL USA

STS-71/Mir/Spacelab Landing at KSC

Jul. 07, 1995; In English; Videotape: 57 min. 27 sec. playing time, in color, with sound

Report No.(s): NONP-NASA-VT-2000036562; No Copyright; Avail: CASI; B03, Videotape-Beta; V03, Videotape-VHS

Live footage of various day landing views of the Spacecraft Atlantis are shown from different camera sites. Also shown is the re-entry and day landing of the spacecraft at Kennedy Space Center. Footage also includes touchdown, drag chute deployment, nose gear touchdown, and the ground recovery crew as they travel to the spacecraft. Atlantis crew, Commander Robert L. Gibson, Pilot Charles J. Precourt, Mission Specialists Ellen S. Baker, Bonnie J. Dunbar, Gregory B. B. Burch, and the download crew from MIR-18 Norman E. Thagard, Vladimir Dezhurov, and Gennadiy Strekalov are also seen leaving the craft. Included is a phone conversation between President Clinton and the crew.

CASI

Spacecraft Landing; Touchdown; Reentry; Descent; Drag Chutes

20000030669 NASA Kennedy Space Center, Cocoa Beach, FL USA

STS-37 Landing

Apr. 11, 1991; In English; Videotape: 45 min. 35 sec. playing time, in color, with sound

Report No.(s): NONP-NASA-VT-2000013429; No Copyright; Avail: CASI; B03, Videotape-Beta; V03, Videotape-VHS

Live footage shows the STS-37 Spacecraft as it re-enters the Earth's atmosphere for a morning landing. The Atlantis spacecraft is seen making a 270-degree turn in its approach attempts to land on runway 33 at Edwards Air Force Base. Also shown are the touchdown of the main and nose gears, and Atlantis' rollout on the runway. The STS-37 crewmembers, Commander Steven R. Nagel, Pilot Kenneth D. Cameron, Mission Specialists Jerry L. Ross, Jay Apt, and Linda M. Godwin, are shown departing the vehicle, posing for photographs, and boarding the Astro-van. Included are also various landing from many different cameras.

CASI

Touchdown; Spacecraft Landing; Approach; Flight Paths; Landing Gear

20000031349 NASA Kennedy Space Center, Cocoa Beach, FL USA

STS-37/GRO Crew Arrival and TCDT Activities

Mar. 19, 1991; In English; Videotape: 13 min. 32 sec. playing time, in color, with sound

Report No.(s): NONP-NASA-VT-2000013431; No Copyright; Avail: CASI; B01, Videotape-Beta; V01, Videotape-VHS

Live footage shows the night arrival of the T-38 training aircraft. The crewmembers of STS-37, Commander Steven R. Nagel, Pilot Kenneth D. Cameron, Mission Specialists Jerry L. Ross, Jay Apt, and Linda M. Godwin, are seen participating in the Terminal Countdown Demonstration Tests (TCDT). The crew made statements and answer questions from the press. The shuttle is also shown on the pad.

CASI

Astronaut Training; Equipment Specifications; T-38 Aircraft; Crew Procedures (Preflight)

20000032471 NASA Kennedy Space Center, Cocoa Beach, FL USA

STS-35: Astro-1 BBXRT Problem Area

Aug. 31, 1990; In English; Videotape: 5 min. playing time, in color, no sound

Report No.(s): NONP-NASA-VT-2000043342; No Copyright; Avail: CASI; B01, Videotape-Beta; V01, Videotape-VHS

The primary objective of STS-35 was to conduct observations in ultraviolet and X-ray astronomy with the ASTRO-1 observatory. ASTRO-1 consisted of four telescopes: Hopkins Ultraviolet Telescope (HUT); Wisconsin Ultraviolet Photo-Polarimeter Experiment (WUPPE); Ultraviolet Imaging Telescope (UIT); and Broad Band X-ray Telescope (BBXRT). This videotape shows work on the BBXRT in the clean room. Two days before a scheduled September 1 launch date, the avionics box on the BBXRT malfunctioned and had to be changed and retested.

CASI

Avionics; X Ray Telescopes; Clean Rooms

20000027509 NASA Langley Research Center, Hampton, VA USA

Dynamic Stability Testing of the Genesis Sample Return Capsule

Cheatwood, F. McNeil, NASA Langley Research Center, USA; Winchenbach, Gerald L., Air Force Research Lab., USA; Hathaway, Wayne, Arrow Tech Associates, Inc., USA; Chapman, Gary, Aerospace Computing, Inc., USA; [2000]; 10p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2000-1009; Copyright Waived; Avail: CASI; A02, Hardcopy; A01, Microfiche

This paper documents a series of free flight tests of a scale model of the Genesis Sample Return Capsule. These tests were conducted in the Aeroballistic Research Facility (ARF), located at Eglin AFB, FL, during April 1999 and were sponsored by NASA Langley Research Center. Because these blunt atmospheric entry shapes tend to experience small angle of attack dynamic instabilities (frequently leading to limit cycle motions), the primary purpose of the present tests was to determine the dynamic stability characteristics of the Genesis configuration. The tests were conducted over a Mach number range of 1.0 to 4.5. The results for this configuration indicate that the models were dynamically unstable at low angles of attack for all Mach numbers tested. At Mach numbers below 2.5, the models were also unstable at the higher angles of attack (above 15 deg), and motion amplitudes of up to 40 deg were experienced. Above Mach 2.5, the models were dynamically stable at the higher angles of attack.

Author

Dynamic Stability; Genesis Mission; Space Capsules; Flight Stability Tests

11

CHEMISTRY AND MATERIALS (GENERAL)

Includes general research topics related to the composition, properties, structure, and use of chemical compounds and materials as they relate to aircraft, launch vehicles, and spacecraft.

20000032863 Pisa Univ., Dept. of Aerospace Engineering, Italy

Damage Tolerance Characteristics of Composite Sandwich Structures

Lazzeri, L., Pisa Univ., Italy; Mariani, U., Agusta S.p.A., Italy; Application of Damage Tolerance Principles for Improved Airworthiness of Rotorcraft; February 2000, pp. 4 - 1 - 4 - 6; In English; See also 20000032859; Copyright Waived; Avail: CASI; A02, Hardcopy

Current damage tolerance requirements impose strict constraints on the design of composite aircraft structures, since the various forms of defects taken into consideration must show "no-growth" characteristics in the environmental and loading conditions expected in the operative life. A research activity was carried out by Agusta, in collaboration with the University of Pisa, with the purpose of assessing the damage tolerance characteristics of typical composite sandwich structures used by the helicopter industry. A particular effort was dedicated to the study of delamination growth under compression loading, a basic step for understanding the damage tolerance behaviour of composite structures. The results of the numerical analysis carried out show that G, the Strain Energy Release Rate, is a suitable parameter for describing the behaviour of the delamination, but it is essential to consider its partition according to the fundamental modes.

Author

Helicopter Design; Aircraft Structures; Composite Structures; Damage; Delaminating; Helicopters; Sandwich Structures; Tolerances (Mechanics)

20000032864 Imperial Coll. of Science, Technology and Medicine, Dept. of Aeronautics, London, UK

Damage Tolerance to Low Velocity Impact of Laminated Composites

Davies, G. A. O., Imperial Coll. of Science, Technology and Medicine, UK; Hitchings, D., Imperial Coll. of Science, Technology and Medicine, UK; Zhang, X., Imperial Coll. of Science, Technology and Medicine, UK; Application of Damage Tolerance Principles for Improved Airworthiness of Rotorcraft; February 2000, pp. 6 - 1 - 6 - 13; In English; See also 20000032859; Sponsored in part by British Aerospace (Military and Aerostructure); Copyright Waived; Avail: CASI; A03, Hardcopy

A strategy is developed for predicting easily the threshold energy for delamination caused by impact, whatever the nature of the laminated structure. The actual delamination and fiber damage is also predicted and the consequent compression-after-impact strengths. The latter strategies may be approximate but current research is pointing the way to more accurate solutions based on finding energy-release-rates around the delamination front.

Author

Delaminating; Tolerances (Mechanics); Impact Damage; Aircraft Structures; Composite Structures; Impact Resistance

20000032867 Eurocopter Deutschland G.m.b.H., Munich, Germany

Fatigue Substantiation and Damage Tolerance Evaluation of Fiber Composite Helicopter Components

Bansemir, H., Eurocopter Deutschland G.m.b.H., Germany; Emmerling, S., Eurocopter Deutschland G.m.b.H., Germany; Application of Damage Tolerance Principles for Improved Airworthiness of Rotorcraft; February 2000, pp. 11 - 1 - 11 - 11; In English; See also 20000032859

Report No.(s): ECD-0096-99-PUB; Copyright Waived; Avail: CASI; A03, Hardcopy

Helicopter rotor systems are dynamically loaded structures with many composite components such as main and tail rotor blades and rotor hubs. The new civil helicopter EC135 has a bearingless main rotor system certified according to the "Special Condition for Primary Structures Designed with Composite Material" of the German airworthiness authority LBA containing increased safety demands. This special condition addresses subjects like: demonstration of ultimate load capacity including consideration of manufacturing and impact damages; fatigue evaluation for parts suitable or unsuitable for damage tolerance method and the related inspection procedures; investigation of growth rate of damages that may occur from fatigue, corrosion, intrinsic, and manufacturing defects or damages from discrete sources under repeated loads expected in service; residual strength requirements; consideration of the effects of material variability and environmental conditions like hot/wet strength degradation etc.; and substantiation of bonded joints. The fatigue tolerance evaluation and damage tolerance substantiation for composite structures are shown in this paper. The fulfillment of the "Special Conditions" is demonstrated for the main rotor blade of the EC135. The fatigue tolerance evaluation and damage tolerance substantiation for composite structures are shown in this paper. The fulfillment of the 'Special Conditions' is demonstrated for the main rotor blade of the EC 135.

Author

Aircraft Reliability; Composite Materials; Composite Structures; Damage; Degradation; Fiber Composites; Helicopters; Impact Damage; Rotary Wings; Tolerances (Mechanics); Fatigue (Materials); C-135 Aircraft

20000028400 Tsentralni Aerogidrodinamicheskii Inst., Zhukovsky, Russia

Experimental Investigation of Supersonic Combustion of Liquid Hydrocarbon Fuel Using Barbotage in the Aeroramp Configuration at $M = 2.5$ Final Report

Sabel'nikov, Vladimir; Dec. 10, 1999; 51p; In English

Contract(s)/Grant(s): F61775-99-W-E050

Report No.(s): AD-A373147; EOARD-SPC99-4050; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Results of investigations of combustion of liquid hydrocarbon fuel jets aerated by air in a supersonic flow in the two-dimensional diverging-area supersonic combustor are presented. Direct-connect combustor tests were conducted at the combustor entrance Mach number $M=2.5$ and total temperature in the range of $T_t = 1635-1742K$. The liquid hydrocarbon fuel supply into the combustor was executed through the modified (in comparison with the baseline) aeroramp configurations: 1) installation of baseline aeroramps at the upper and bottom walls of the combustor, 2) combined fuel feed through injector nozzles of aeroramps separately of air and of fuel aerated by air, 3) injectors with the different from baseline aeroramps angles of fuel injection and geometry nozzles. The results obtained with the modified aeroramp configurations are superior to earlier ones obtained with baseline aeroramp configuration.

DTIC

Supersonic Combustion; Liquid Fuels; Hydrocarbon Combustion; Hydrocarbon Fuels

20000032117 Boeing Commercial Airplane Co., Seattle, WA USA

Validated Feasibility Study of Integrally Stiffened Metallic Fuselage Panels for Reducing Manufacturing Costs: Cost Assessment of Manufacturing/Design Concepts *Final Report*

Metschan, S., Boeing Commercial Airplane Co., USA; February 2000; 26p; In English

Contract(s)/Grant(s): NAS1-20014; NAS1-20267; RTOP 522-12-51-01

Report No.(s): NASA/CR-2000-209343; NAS 1.26:209343; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The objective of the Integral Airframe Structures (IAS) program was to demonstrate, for an integrally stiffened structural concept, performance and weight equal to "built-up" structure with lower manufacturing cost. This report presents results of the cost assessment for several design configuration/manufacturing method combinations. The attributes of various cost analysis models were evaluated and COSTRAN selected for this study. A process/design cost evaluation matrix was developed based on material, forming, machining, and assembly of structural sub-elements and assembled structure. A hybrid design, made from high-speed machined extruded frames that are mechanically fastened to high-speed machined plate skin/stringer panels, was identified as the most cost-effective manufacturing solution. Recurring labor and material costs of the hybrid design are up to 61 percent less than the current built-up technology baseline. This would correspond to a total cost reduction of \$1.7 million per ship set for a 777-sized airplane. However, there are important outstanding issues with regard to the cost of capacity of high technology machinery, and the ability to cost-effectively provide surface finish acceptable to the commercial aircraft industry. The projected high raw material cost of large extrusions also played an important role in the trade-off between plate and extruded concepts.

Author

Airframes; Cost Analysis; Fuselages; Manufacturing; Feasibility Analysis; Rigid Structures

20000031340 Dayton Univ., OH USA

Biodegradation of Polymeric Coatings and Corrosion of Aircraft Materials *Final Report, 1 Apr.-31 Oct. 1998*

Trick, Kimberly A.; Jul. 07, 2000; 8p; In English

Contract(s)/Grant(s): F49620-98-1-0297

Report No.(s): AD-A373562; AFRL-SR-BL-TR-00-0033; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

During the reporting period, FY 99, substantial progress was made toward modifying an instrumentation design that will allow micro study of biodegradation and corrosion mechanisms. A Quartz Electrochemical Micro Balance (QEMB) system has been designed and six systems have been constructed and calibrated. These units will be interfaced with a data acquisition system to monitor reactions and study degradation mechanisms of polymeric coatings in a variety of biological environments.

DTIC

Biodegradation; Polymeric Films; Corrosion; Aircraft Equipment; Data Acquisition

20000028397 British Petroleum Co. Ltd., Amoco Oil, Sunbury-on-Thames, UK

Design and Current Status of Development of a Jet Fuel Thermal Stability Additive

Taylor, Spencer E., British Petroleum Co. Ltd., UK; Sep. 10, 1999; 10p; In English

Report No.(s): AD-A373364; ISABE-99-7276; Copyright; Avail: Defense Technical Information Center (DTIC)

An initiative led by the US Air Force concluded that advances in military fighter aircraft systems would require fuels with over 50% improvement in heat sink capability over conventional JP8 fuel. This led to the creation of the "JP8+100" program during which hundreds of commercial additives were tested for thermal stability enhancing characteristics. The program demonstrated that the thermal stability of jet fuels (particularly JPS) could be enhanced through the use of particular additives and additive blends used at relatively low concentrations. Additionally, flight testing highlighted a significant reduction in fuel- and related maintenance costs, arising from cleaner combustion. One aspect of the incorporation of the most beneficial additives from a thermal stability viewpoint that has given some cause for concern, however, is the consequent effect on the water and solids separation from "JP8+100" fuel, a feature minimized by introduction of the "+100" additive as close to the skin of the aircraft as possible. Inspired by the USAF success, and anticipated consequential environmental benefits, we have conducted an experimental program for the design and development of a conceptually new multifunctional molecular species to enhance the thermal stability of jet fuels, without compromising other required essentials of jet a fuel product quality.

DTIC

Jet Engine Fuels; Additives; Thermal Stability; Flight Tests

20000031335 Coordinating Research Council, Inc., Atlanta, GA USA

Development of a Test Method for the Determination of the Hydroperoxide Potential and Antioxidant Effectiveness in Jet Fuels During Long Term Storage *Final Report, 1 Jun. 1994-1 Mar 1999*

Sep. 1999; 51p; In English

Contract(s)/Grant(s): F33615-94-C-2401; AF Proj. 3048

Report No.(s): AD-A373517; CRC-614; AFRL-PR-WP-TR-1999-2119; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

A reliable test method is needed for predicting the long term storage stabilities of military aviation turbine fuel reserves as well as for evaluating the effectiveness of antioxidants approved for these fuels. This report addresses this need. It describes a reliable and practical accelerated test method for predicting the peroxidation potential of aviation turbine fuels that are stored for long term periods. A test methodology is also proposed for evaluating antioxidants for future qualification in the military specification, MIL-T-5624. This paper is based on the collective results of extensive rigorous studies performed by the four participating laboratories: Southwest Research Institute (SwRI), San Antonio, Texas; Naval Research Laboratory (NRL) Washington, D.C.; Naval Air Warfare Center (NAWC), Trenton, New Jersey; and the National Institute of Petroleum and Energy Research (NIPER), Bartlesville, Oklahoma.

DTIC

Jet Engine Fuels; Antioxidants; Storage; Materials Handling

12

ENGINEERING (GENERAL)

Includes general research topics to engineering and applied physics, and particular areas of vacuum technology, industrial engineering, cryogenics, and fire prevention.

20000033302 Georgia Inst. of Tech., Systems Realization Lab., Atlanta, GA USA

The Problem of Size in Robust Design

Koch, Patrick N., Georgia Inst. of Tech., USA; Allen, Janet K., Georgia Inst. of Tech., USA; Mistree, Farrokh, Georgia Inst. of Tech., USA; Mavris, Dimitri, Georgia Inst. of Tech., USA; 1997; 12p; In English; Design Engineering Technical, 14-17 Sep. 1997, Sacramento, CA, USA; Sponsored by American Society of Mechanical Engineers, USA; Sponsored in part by Gwaltney

Contract(s)/Grant(s): NGT-51102; NSF DMI-96-12365

Report No.(s): DETC97/DAC-3983; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

To facilitate the effective solution of multidisciplinary, multiobjective complex design problems, a departure from the traditional parametric design analysis and single objective optimization approaches is necessary in the preliminary stages of design. A necessary tradeoff becomes one of efficiency vs. accuracy as approximate models are sought to allow fast analysis and effective exploration of a preliminary design space. In this paper we apply a general robust design approach for efficient and comprehensive preliminary design to a large complex system: a high speed civil transport (HSCT) aircraft. Specifically, we investigate the HSCT wing configuration design, incorporating life cycle economic uncertainties to identify economically robust solutions. The approach is built on the foundation of statistical experimentation and modeling techniques and robust design principles, and is specialized through incorporation of the compromise Decision Support Problem for multiobjective design. For large problems however, as in the HSCT example, this robust design approach developed for efficient and comprehensive design breaks down with the problem of size - combinatorial explosion in experimentation and model building with number of variables -and both efficiency and accuracy are sacrificed. Our focus in this paper is on identifying and discussing the implications and open issues associated with the problem of size for the preliminary design of large complex systems.

Author

Experiment Design; Supersonic Transports; Complex Systems; Robustness (Mathematics); Mathematical Models; Aircraft Design; Computer Aided Design; Decision Support Systems

20000032367 EDS Defence Ltd., Fleet, UK

Analysis of Combat System Demands on a C3IS Architecture

Ashton, M., EDS Defence Ltd., UK; Miller, G. D., Defence Evaluation Research Agency, UK; Morgan, P. D., EDS Defence Ltd., UK; Modelling and Analysis of Command and Control; June 1999, pp. 6-1 - 6-10; In English; See also 20000032361

Contract(s)/Grant(s): MOD-CDA/E/295; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

A military Command, Control, Communications and Intelligence System (C3IS) provides a Commander with the means of directing and coordinating the operation of his combat resources to achieve his tactical objectives within his operational environment; this requires that the facilities provided by the C3IS match the scope of the tactical objectives, the vagaries of the operational environment and the demands of the various combat resources. In general, C3IS development has followed an evolutionary path in response to the progressive improvement of individual combat systems; however, there are a few occasions when the introduction into service of a new combat system has led to the need to examine the implications for the C3IS. The

majority of these have been when the combat system offered a major improvement to the war fighting capability of the force; the arrival during the next few years of the Attack Helicopter (AH) into the British Army's inventory is perceived to be just such an occasion. The modern Attack Helicopter with its onboard mission planning systems and its data transfer communication capabilities is expected to have a major influence on future C3IS requirements of ground forces. The introduction of the Attack Helicopter with its range of new and extended capabilities will enhance the British Army's effectiveness and range of options in a variety of scenarios; however, the control and management of these new capabilities are expected to place new demands on the C3IS which may require modification or extension of the existing C3IS architecture. This paper describes an integrated modelling approach that was developed to support investigation of the C3IS and AH Mission Management System capabilities that will be needed to maximize the effectiveness of battlefield aviation; it discusses the application of the approach, showing how it was used to meet the study requirements.

Derived from text

Command and Control; Helicopters; Support Systems; Combat; Information Systems; Mission Planning; Management Systems

20000028394 National Technical Univ., Lab. of Thermal Turbomachines, Athens Greece

Effect of Wall Rotation on the Performance of a High-Speed Compressor Cascade with Tip Clearance

Doukelis, A., National Technical Univ., Greece; Mathioudakis, K., National Technical Univ., Greece; Papailiou, K., National Technical Univ., Greece; Sep. 10, 1999; 7p; In English

Contract(s)/Grant(s): BRPR-CT97-0610

Report No.(s): AD-A373360; ISABE-99-7267; No Copyright; Avail: CASI; A01, Microfiche; A02, Hardcopy

In the present work, the influence of the magnitude of the relative wall speed on the performance of an annular compressor cascade with tip clearance, is examined. Five-hole probe measurements, conducted at the inlet and outlet of the cascade, are used to derive blade performance characteristics, in the form of loss and turning distributions. Characteristics are presented in the form of circumferentially mass averaged profiles, while distributions on the exit plane provide information useful to interpret the performance of the blading. Four different rotational speeds of the hub have been examined, giving the possibility to observe the dependence of performance characteristics on hub rotational speed. Increasing the rotational speed is found to improve the performance of the cascade by decreasing losses in the clearance region, while it affects the flow in the entire passage.

DTIC

Turbomachinery; Boundary Layer Flow; Compressors; Cascade Flow; Annular Flow

20000028398 Industria de Turbo Propulsores S.A., Aerothermal and Systems Dept., Madrid, Spain

Particle Dynamics Simulation for Aeroengine Intake Design

delaCazada, P., Industria de Turbo Propulsores S.A., Spain; Vazquez, R., Industria de Turbo Propulsores S.A., Spain; Fernandez, F., Industria de Turbo Propulsores S.A., Spain; San Segundo, M. P., Industria de Turbo Propulsores S.A., Spain; Sep. 10, 1999; 7p; In English

Report No.(s): AD-A373365; ISABE-99-7280; No Copyright; Avail: CASI; A01, Microfiche; A02, Hardcopy

The design of an engine intake comprising an inertial inlet particle separator is accomplished under this work. With that purpose a Navier Stokes solver is used for aerodynamics performance investigation for design and off design conditions and the particle trajectories are obtained using a post process tool. In order to obtain the particle trajectories the equations of particle dynamics are integrated following an explicit scheme. The time step limitations of the explicit method depending on the particle size and Reynolds number are discussed and some details of the methodology followed to integrate the equations on the discredited domain are given. Finally, aerodynamics results of the intake are shown and the particle trajectories for a wide range of particles sizes are obtained in order to assess the separation efficiency of the intake system.

DTIC

Turboprop Engines; Computational Fluid Dynamics; Particle Motion; Computerized Simulation; Navier-Stokes Equation

20000032220 Florida Agricultural and Mechanical Univ., Center for Nonlinear and Nonequilibrium Aeroscience, Tallahassee, FL USA

Water Injection for Mixing Noise Reduction of a Heated Supersonic Rectangular Jet

Washington, D.; Krothapalli, A.; NASA University Research Centers Technical Advances in Aeronautics, Space Sciences and Technology, Earth Systems Sciences, Global Hydrology, and Education; Feb. 22, 1998; Volumes 2 and 3, pp. 67-70; In English; See also 20000032189; No Copyright; Avail: CASI; A01, Hardcopy; A10, Microfiche; C01, CD-ROM

Over the past several decades researchers have been interested in reducing the noise of supersonic jets. The starting point for most of these noise suppression techniques comes from theories concerning aerodynamic noise from Lighthill's analogy. In Lighthill's theory, the equations of motion are broken down into the inhomogeneous wave equation where a distribution of

acoustic sources (in the flow field) are responsible for the inhomogeneous terms. Unfortunately, this source distribution is of unknown origin and magnitude. Consequently researchers have had difficulties devising effective noise suppression techniques without incurring significant thrust penalties on existing aircraft. One currently available noise suppression method is to use non-circular nozzle geometries in order to produce streamwise vortices in the jet flow field. This idea comes from Pannu and Johannesen who suggested that these types of structures could redirect the noise in jets. However, subsequent investigations have shown that streamwise vortices create at best only modest magnitudes of noise reduction in the jet Overall Sound Pressure Level (OASPL). Despite the many active and passive noise suppression schemes devised by researchers until now, no method has been developed which has lead to OASPL reductions significant enough for use in the High Speed Civil Transport (HSCT) program. In 1970's, a 15 percent thrust penalty was sustained in order to produce a 12 dB reduction in jet noise. Similarly, in the 80's and 90's this improved to a 7 and 5 percent thrust penalty respectively, to reach this 12 dB reduction. However, the goal of the HSCT program currently has not been met, since it requires that a 12 dB reduction in jet noise can have at most a 2.5 percent thrust penalty. Evidence has been presented in the current paper which supports the idea that the source of the turbulent mixing noise is located downstream of the potential core. In an effort to suppress the turbulent mixing noise, atomized water is injected into a heated Mach 2.0 rectangular jet. The injection of water into the jet causes a change in the overall structure of the shear-layer instabilities. It is believed that the shear-layer modification attributed to water injection will cause a reduction of the OASPL in the jet even for low mass flow ratios of water to air (approximately 0.1). This assertion comes from the fact that a portion of the jet energy will be required to complete the evaporation process of the atomized water. Furthermore, the momentum exchange between the water and air in the jet shear-layer will add to this OASPL suppression. Thus, preliminary experimental results have shown positive benefits toward mixing noise reduction. In addition to the results already presented aerodynamic experiments will be conducted in the future. These experiments will consist of pressure surveys, PLS images, PIV, and IR images. The combination of this experimental data will be used to determine how the shear-layer dynamics of the jet are modified as water is injected into the jet. This will allow us to interpret the results of the far-field acoustic measurement that will also be obtained in a subsequent investigation.

Derived from text

Jet Aircraft Noise; Noise Reduction; Supersonic Jet Flow; Supersonic Transports; Turbulent Mixing; Water Injection; Wave Equations; Acoustic Measurement; Equations of Motion

20000032608 Saitama Inst. of Tech., Saitama, Japan

Oblique Reflection of a Weak Shock Wave: Three-Shock Theory with Divergence Effect of Slipstream

Kobayashi, Susumu, Saitama Inst. of Tech., Japan; Adachi, Takashi, Saitama Inst. of Tech., Japan; Suzuki, Tateyuki, Toyama Prefectural Univ., Japan; Journal of Saitama Institute of Technology; 1992; ISSN 0918-8177, pp. 22-29; In English; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Oblique reflection of a weak shock wave is investigated numerically. A modified three-shock theory is introduced to explain the well-known von Neumann paradox for weak Mach reflection. The effect of divergence of slipstream behind the triple point is taken into account. The angle of divergence is given parametrically to calculate some characteristics around the triple point, e.g., the angle of reflection. Numerical results are compared with experiment. It is shown that for weak Mach reflection, the modified three-shock theory gives physically realistic solutions, even when von Neumann's three-shock theory has no solution. All the experimental data lie in the domain given by the modified three-shock theory proposed here.

Author

Reflected Waves; Shock Waves; Slipstreams; Mach Reflection; Plane Waves; Transonic Speed; Wedges

20000033412 Chinese Inst. of Engineers, Taipei, Taiwan, Province of China

Experimental Study on Heat Transfer and Friction in Pin Fin Channel Flow

You, Hisien-I, National Chung Hsing Univ., Taiwan, Province of China; Chang, Chung-Hsing, National Chung Hsing Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers; 2000; ISSN 0253-3839; Volume 23, No. 1, pp. 117-123; In English

Contract(s)/Grant(s): NSF-83-0401-E005-068; Copyright; Avail: Issuing Activity

Experimental work is conducted to examine the effect of porosity, originated from the theory of the porous medium flow, on both the heat transfer rate and friction behavior for flow through a pin fin channel. Four units of the pin fin matrix having different porosities are used in the flow test. The heat transfer rates are obtained using the LMTD method. It is found that the heat transfer rate is higher for flow through a high porosity pin fin matrix, which possesses a higher heating surface area. For a relatively large Reynolds number flow, the friction factors are found to depend only on the flow porosity due to the presence of the

roughness-like pin fin protruding through the viscous sublayer. Average friction factors are then suggested for every pin fin channel.

Author

Experimentation; Data Acquisition; Heat Transfer; Friction; Pins; Fins; Channel Flow

20000033269 NASA Marshall Space Flight Center, Huntsville, AL USA

Fretting Stresses in Single Crystal Superalloy Turbine Blade Attachments

Arakere, Nagaraj K., Florida Univ., USA; Swanson, Gregory, NASA Marshall Space Flight Center, USA; [2000]; 36p; In English; Joint Tribology Conference, 1-4 Oct. 2000, Seattle, WA, USA; Sponsored by American Society of Mechanical Engineers, USA Contract(s)/Grant(s): RTOP 260-40-03

Report No.(s): ASME-Trib-61; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Single crystal nickel base superalloy turbine blades are being utilized in rocket engine turbopumps and turbine engines because of their superior creep, stress rupture, melt resistance and thermomechanical fatigue capabilities over polycrystalline alloys. Currently the most widely used single crystal nickel base turbine blade superalloys are PWA 1480/1493 and PWA 1484. These alloys play an important role in commercial, military and space propulsion systems. High Cycle Fatigue (HCF) induced failures in aircraft gas turbine and rocket engine turbopump blades is a pervasive problem. Blade attachment regions are prone to fretting fatigue failures. Single crystal nickel base superalloy turbine blades are especially prone to fretting damage because the subsurface shear stresses induced by fretting action at the attachment regions can result in crystallographic initiation and crack growth along octahedral planes. Furthermore, crystallographic crack growth on octahedral planes under fretting induced mixed mode loading can be an order of magnitude faster than under pure mode I loading. This paper presents contact stress evaluation in the attachment region for single crystal turbine blades used in the NASA alternate Advanced High Pressure Fuel Turbo Pump (HPFTP/AT) for the Space Shuttle Main Engine (SSME). Single crystal materials have highly orthotropic properties making the position of the crystal lattice relative to the part geometry a significant factor in the overall analysis. Blades and the attachment region are modeled using a large-scale 3D finite element (FE) model capable of accounting for contact friction, material orthotropy, and variation in primary and secondary crystal orientation. Contact stress analysis in the blade attachment regions is presented as a function of coefficient of friction and primary and secondary crystal orientation. Stress results are used to discuss fretting fatigue failure analysis of SSME blades. Attachment stresses are seen to reach peak values at locations where fretting cracks have been observed. Fretting stresses at the attachment region are seen to vary significantly as a function of crystal orientation. Attempts to adapt techniques used for estimating fatigue life in the airfoil region, for life calculations in the attachment region, are presented. An effective model for predicting crystallographic crack initiation under mixed mode loading is required for life prediction under fretting action.

Author

Fretting; Single Crystals; Stress Analysis; Turbine Blades; Mathematical Models; Turbine Engines; Heat Resistant Alloys

20000028356 University of Central Florida, Mechanical, Materials and Aerospace Engineering, Orlando, FL USA

A New Real - Time Fault Detection Methodology for Systems Under Test, Phase I

Johnson, Roger W., University of Central Florida, USA; Jayaram, Sanjay, University of Central Florida, USA; Hull, Richard A., University of Central Florida, USA; Sep. 19, 1998; 44p; In English

Contract(s)/Grant(s): NAS10-0147; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The purpose of this research is focussed on the identification/demonstration of critical technology innovations that will be applied to various applications viz. Detection of automated machine Health Monitoring (BM, real-time data analysis and control of Systems Under Test (SUT). This new innovation using a High Fidelity Dynamic Model-based Simulation (BFDMS) approach will be used to implement a real-time monitoring, Test and Evaluation (T&E) methodology including the transient behavior of the system under test. The unique element of this process control technique is the use of high fidelity, computer generated dynamic models to replicate the behavior of actual Systems Under Test (SUT). It will provide a dynamic simulation capability that becomes the reference truth model, from which comparisons are made with the actual raw/conditioned data from the test elements.

Derived from text

Real Time Operation; Fault Detection; Simulation; Control Systems Design; Automatic Control; Flight Control; System Identification

20000032870 Sikorsky Aircraft, Stratford, CT USA

Flaw Tolerant Safe-Life Methodology

Adams, D. O., Sikorsky Aircraft, USA; Application of Damage Tolerance Principles for Improved Airworthiness of Rotorcraft; February 2000, pp. 14 - 1 - 14 - 8; In English; See also 20000032859; Copyright Waived; Avail: CASI; A02, Hardcopy

Conventional safe-life methodology has been in general use in the helicopter industry for more than 40 years to substantiate fatigue-loaded dynamic components. However, it is seen to need improvement. One improvement is to reduce its sensitivity to the strength-reducing effects of flaws and defects that may occur in manufacturing and service use. Damage Tolerance methodology provides a means to accomplish this improvement but it is currently difficult to economically apply it to every fatigue mode on every component. Flaw Tolerant methodology is an available equal-choice option to Damage Tolerance for Transport Category civil rotorcraft, and it is offered here as a practical improvement to conventional safe life for military applications as well. Flaw Tolerance, which is based on the characteristics of initiation of cracks from flaws, is described and illustrated by means of examples of successful applications to helicopter components.

Author

Damage; Helicopters; Rotary Wing Aircraft; Tolerances (Mechanics); Helicopter Design; Aircraft Reliability; Aircraft Structures; Design Analysis; Cracks

20000032871 Eurocopter France, Etablissement de Marignane, Marignane, France

Damage Tolerance Applied on Metallic Components

Marquet, Thierry, Eurocopter France, France; Struzik, Alain, Eurocopter France, France; Application of Damage Tolerance Principles for Improved Airworthiness of Rotorcraft; February 2000, pp. 15 - 1 - 15 - 14; In English; See also 20000032859; Copyright Waived; Avail: CASI; A03, Hardcopy

New requirements including damage tolerance were inserted in FAR 29.571, amendment 28 in 1989 to increase the safety level of helicopters. ("Flaw tolerance safe life" and "fail safe" - or a combination thereof, were proposed to fulfill the damage tolerance requirements. If impractical, "safe life" evaluation was acceptable.) A working group called TOGAA was mandated by the US Senate to propose modifications to the FAA rules. Harmonised recommendations from rotorcraft manufacturers (RCWG) had been gathered in a "White Paper". The TOGAA commented this methodology and concluded in mid 1998, that the "flaw tolerant safe life" concept should be purged in FAR 29, and advocated the exclusive use of crack propagation for single and multiple load paths. This paper presents EUROCOPTER's statistical analyses of the root causes of accident in flight. EUROCOPTER's philosophy in reply to FAR & JAR 29-571 is detailed, showing a significant and measurable improvement over conventional "safe-life" methodology. This philosophy has already been applied to several current projects (EC 155, NH 90), and the RCWG simply wanted it to be left in the current rules.

Author

Damage; Tolerances (Mechanics); Statistical Analysis; Rotary Wing Aircraft; Helicopters; Crack Propagation; Metals; Aircraft Reliability; Helicopter Design; Design Analysis

20000032046 Washington Univ., Dept. of Aeronautics and Astronautics, Seattle, WA USA

Structural Design Methodology Based on Concepts of Uncertainty Final Report, 16 May 1998 - 30 Sep. 1999

Lin, K. Y., Washington Univ., USA; Du, Jiaji, Washington Univ., USA; Rusk, David, Washington Univ., USA; February 2000; 130p; In English

Contract(s)/Grant(s): NAG1-2055; RTOP 522-31-71-02

Report No.(s): NASA/CR-2000-209847; NAS 1.26:209847; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

In this report, an approach to damage-tolerant aircraft structural design is proposed based on the concept of an equivalent "Level of Safety" that incorporates past service experience in the design of new structures. The discrete "Level of Safety" for a single inspection event is defined as the compliment of the probability that a single flaw size larger than the critical flaw size for residual strength of the structure exists, and that the flaw will not be detected. The cumulative "Level of Safety" for the entire structure is the product of the discrete "Level of Safety" values for each flaw of each damage type present at each location in the structure. Based on the definition of "Level of Safety", a design procedure was identified and demonstrated on a composite sandwich panel for various damage types, with results showing the sensitivity of the structural sizing parameters to the relative safety of the design. The "Level of Safety" approach has broad potential application to damage-tolerant aircraft structural design with uncertainty.

Author

Structural Design; Aircraft Structures; Probability Theory; Aircraft Safety; Fault Tolerance

20000032101 Old Dominion Univ., Dept. of Aerospace Engineering, Norfolk, VA USA

Structure Damage Simulations Accounting for Inertial Effects and Impact and Optimization of Grid-Stiffened Non-Circular Shells Final Report, 1 Jan. 1994 - 31 Oct. 1999

Mei, Chuh, Old Dominion Univ., USA; Jaunky, Navin, Old Dominion Univ., USA; Nov. 08, 1999; 40p; In English

Contract(s)/Grant(s): NCC1-284; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The goal of this research project is to develop modelling and analysis strategy for the penetration of aluminium plates impacted by titanium impactors. Finite element analysis is used to study the penetration of aluminium plates impacted by titanium impactors in order to study the effect of such uncontained engine debris impacts on aircraft-like skin panels. LS-DYNA3D) is used in the simulations to model the impactor, test fixture frame and target barrier plate. The effects of mesh refinement, contact modeling, and impactor initial velocity and orientation were studied. The research project also includes development of a design tool for optimum design of grid-stiffened non-circular shells or panels subjected to buckling.

Author

Aircraft Structures; Finite Element Method; Grid Generation (Mathematics); Impactors; Titanium; Impact Damage; Buckling; Models

20000032861 Defence and Evaluation Research Agency, Farnborough, UK

The Development of a Robust Crack Growth Model for Rotorcraft Metallic Structures

Cook, R, Defence and Evaluation Research Agency, UK; Wood, P. C., Westland Helicopters Ltd., UK; Jenkins, S., Westland Helicopters Ltd., UK; Matthew, D., Westland Helicopters Ltd., UK; Irving, P., Cranfield Univ., UK; Austen, I., nCode International Ltd., UK; Buller, R., Westland Design Services Ltd., UK; Application of Damage Tolerance Principles for Improved Airworthiness of Rotorcraft; February 2000, pp. 3 - 1 - 3 - 11; In English; See also 20000032859; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy

In the UK, helicopters have traditionally been designed using safe life principles. However, proposed changes to the airworthiness regulations require that, in the future, structures are qualified using flaw growth methods. Therefore, a robust crack growth model is required. A collaborative project has been undertaken by GKN Westland Helicopters, DERA, Cranfield University and nCode International to develop such a model and define the methodologies required for its implementation. The work was funded by the Department of Trade and Industry and the Ministry of Defence whose support is gratefully acknowledged. This report describes work carried out in the collaborative project and the recommendations formulated. The project consisted of six main areas of investigation namely the derivation of stress intensity factors, determination of typical flight load sequences, measurement of fracture mechanics material properties for use in models, measurement of crack growth data for model verification; evaluation and development of crack growth models, and definition of a helicopter damage tolerance methodology. The project considered two areas of helicopter design, these are: (1) a dynamic rotating component found in a rotorhead; and (2) a typical structural feature in the main load path lift frames. The two areas are fundamentally different and involve different materials and loading actions which may therefore, require different damage tolerance approaches. In this paper each of the six areas of investigation are described, with the main focus on the development and evaluation of crack growth models. The approach used for model development and evaluation was to increase gradually the complexity of the loaded structure. Initially simple compact tension coupons subjected to constant amplitude loading were studied and models were evaluated against test measurements. The complexity of the loading was increased to include discrete loading events, compressive loading events, and finally two representative flight load sequences, Asterix and Rotorix, which were developed during the project. The complexity of the components was also increased, to include part through thickness cracks and finally structural elements representative of features in a rotorhead mast and an area of a main lift frame. At each of these stages, the models were evaluated against experimental measurements. From the results of the investigation, an overall methodology was developed for damage tolerance assessments, although a number of areas require further investigation. The applications and limitations of the approach are presented and recommendations for further work made.

Derived from text

Crack Propagation; Mathematical Models; Metals; Rotary Wing Aircraft; Tolerances (Mechanics); Helicopter Design; Fracture Mechanics; Cracks; Aircraft Structures

20000032873 Department of the Air Force, Engineering Directorate, Wright-Patterson AFB, OH USA

Treatment of High-Cycle Vibratory Stress in Rotorcraft Damage Tolerance Design

Lincoln, John W., Department of the Air Force, USA; Yeh, Hsing C., Department of the Air Force, USA; Application of Damage Tolerance Principles for Improved Airworthiness of Rotorcraft; February 2000, pp. 18 - 1 - 18 - 10; In English; See also 20000032859; Copyright Waived; Avail: CASI; A02, Hardcopy

Fixed wing aircraft manufacturers have adopted the damage tolerance design philosophy with great success for both military and commercial aircraft. However, rotorcraft manufacturers currently still primarily use the classical safe life approach or a modification thereof. One reason for this is that, at this time, no clearly defined damage tolerance design criteria exist for rotorcraft structures because of the analysis and test problems associated with the high cycle loading environment. This paper describes a study performed by the USA Air Force (USAF) to assess the impact of the damage tolerance approach on the design of a rotorcraft component affected by high-cycle vibratory stresses. The assessment consisted of developing the stress spectrum for a critical

rotor system location and performing fracture analyses to determine the potential for establishing inspection intervals based on the damage tolerance approach. They performed sensitivity studies to determine the maximum range truncation that would yield results with acceptable accuracy. They considered the influence of the small-crack effect in all fracture mechanics calculations. The resulting crack growth functions provided the basis for establishing whether an inspection program was viable for the component. They examined the effect of stress reduction measures such as shot peening to enhance the damage tolerance capability of highly stressed components. Therefore, the paper identifies the main issues related to the use of damage tolerance for rotorcraft, and additionally makes recommendations for rotorcraft design criteria.

Author

Helicopter Design; Design Analysis; Cracks; Rotary Wing Aircraft; Fracture Mechanics; Fracturing; Tolerances (Mechanics); Damage; Stress Cycles

13

GEOSCIENCES (GENERAL)

Includes general research topics related to the Earth sciences, and the specific areas of petrology, mineralogy, and general geology.

20000032839 Air Force Systems Command, Wright-Patterson AFB, OH USA

Photovoltaic Electric Power Applied to Unmanned Aerial Vehicles (UAV)

Geis, Jack, Air Force Systems Command, USA; Arnold, Jack H., Rockwell International Corp., USA; Proceedings of the 13th Space Photovoltaic Research and Technology Conference (SPRAT 13); September 1994, pp. 257-268; In English; See also 20000032812; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

Photovoltaic Electric-Powered Flight is receiving a great deal of attention in the context of the USA' Unmanned Aerial Vehicle (UAV) program. This paper addresses some of the enabling technical areas, and their potential solutions. of particular interest are the long-duration, high- altitude class of UAVs whose mission it is to achieve altitudes between 60,000 and 100,000 feet, and to remain at those altitudes for prolonged periods performing various mapping and surveillance activities. Addressed herein are studies which reveal the need for extremely light-weight and efficient solar cells, high-efficiency electric motor-driven propeller modules, and power management and distribution control elements. Since the potential payloads vary dramatically in their power consumption and duty cycles, a typical load profile has been selected to provide commonality for the propulsion power comparisons. Also, since missions vary widely with respect to ground coverage requirements, from repeated orbiting over a localized target, to long-distance routes over irregular terrain, we have also averaged the power requirements for on-board G&C power, as well as ground control and communication link utilization. In the context of the national technology reinvestment program, wherever possible we modeled components and materials which have been qualified for space and defense applications, yet are compatible with civilian UAV activities. These include, but are not limited to solar cell developments, electric storage technology for diurnal operation, local and ground communications, power management and distribution, and control servo design. and finally, the results of tests are presented. These cells were also used for modeling the flight characteristics of UAV aircraft.

Author

Photovoltaic Conversion; Communication Networks; High Altitude; Solar Cells; Surveillance; Technology Utilization; Pilotless Aircraft

20000031635 Naval Facilities Engineering Service Center, Port Hueneme, CA USA

Closed Loop Aircraft Washrack Wastewater Recycle System *Final Report, Oct. 1997-Sep. 1998*

Anguiano, G.; Bonner, R.; Torres, T.; Jun. 1999; 90p; In English

Report No.(s): AD-A372864; UDP-2005-ENV; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Aircraft washing operations generated large quantities of wastewater containing free and emulsified oils, and heavy metals in concentrations frequently exceeding local discharge limits. Oil/water separators have proven ineffective as a pretreatment method prior to discharging the wastewater into a sanitary sewer. The Naval Facilities Engineering Service Center developed and field tested a Closed Loop Aircraft Washrack Wastewater Recycle System (CLAWWRS) based on field-proven chemical treatment followed by pre-coat filtration technologies. The system was integrated with an existing washrack at Marine Corps Air Ground Combat Center, Twenty-nine Palms. Analytical results from field tests showed oil and grease removal to less than 15 ppm, and heavy metals consistently reduced under 0.1 ppm. Additionally, the chloride concentration in the recycle water was maintained well below the maximum allowable level of 400 ppm. Typical fresh water consumption of 100,000 gallons during combined armed exercises was reduced to 15,000 gallons. This User Data Package (UDP) provides information and guidance to activities requiring or using a CLAWWRS for their cleaning operations. This UDP addresses issues concerning economic

feasibility, site selection and preparation, operator requirements and regulatory requirements. CLAWRS operating instructions, system drawings, test data, site preparation requirements, economical analysis, and material safety data sheets can be found in the appendices.

DTIC

Aircraft Maintenance; Waste Water; Fresh Water; Flight Operations; Water Consumption; Washing

14

LIFE SCIENCES (GENERAL)

Includes general research topics related to plant and animal biology (non-human); ecology; microbiology; and also the origin, development, structure, and maintenance, of animals and plants in space and related environmental conditions.

20000027540 Civil Aeromedical Inst., Oklahoma City, OK USA

Blood Carbon Monoxide and Hydrogen Cyanide Concentrations in the Fatalities of Fire and Non-Fire Associated Civil Aviation Accidents, 1991-1998 *Final Report*

Chaturvedi, Arvind K., Civil Aeromedical Inst., USA; Smith, Dudley R., Civil Aeromedical Inst., USA; Canfield, Dennis V., Civil Aeromedical Inst., USA; February 2000; 14p; In English

Report No.(s): DOT/FAA/AM-00/9; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Postmortem blood samples submitted to the Federal Aviation Administration's Civil Aeromedical Institute (CAMI) from fatal civil aviation accident victims are analyzed for the primary toxic combustion gases carbon monoxide (CO), as carboxyhemoglobin (COHb), and hydrogen cyanide, as cyanide (CN). These analyses are performed to establish possible exposure of victims to smoke produced during in-flight/post-crash fires or to CO leaked into cabin/cockpit from faulty exhaust/heating systems. The presence of both gases in blood would suggest that the victim was alive and inhaled smoke from a fire. If only COHb is elevated, then the accident (or death) could be the result of CO contamination of the interior. Information pertaining to blood levels of the 2 gases in aviation fatalities, in relation to the associated accidents, is scattered or not available, particularly with regard to toxicity. Therefore, considering that COHb is greater than or = 10% and CN is greater than or = 0.25 micro-g/mL are sufficient to produce some degree of undesired physiological effects, the necessary information was extracted from the CAMI's toxicology database. Biological samples from 3857 fatalities of 2837 civil aviation accidents, occurring during 1991 - 1998, were received at CAMI. Out of these, 1012 accidents, encompassing 1571 (41%) fatalities, were fire associated, whereas 1820 accidents were non-fire related. The remaining 5 accidents were of unknown fire status. There were fewer fire-related fatalities and associated accidents in the category wherein COHb is greater than or = 10% and CN is greater than or = 0.25 micro-g/mL than that in the category wherein COHb is less than 10% and CN is less than 0.25 micro-g/mL. No in-flight fire was documented in the former category, but in-flight fires were reported in 14 accidents (18 fatalities) in the latter category. No fatality under non-fire accidents was found in which the levels of both gases were determined to be at or above the stated levels. There were 15 non-fire accidents with 17 fatalities in which only COHb (10-69%) was elevated, indicating that these accidents were associated with the inhalation of CO of non-fire origin. The present study suggests that the aviation fire accidents/fatalities were fewer than the aviation non-fire accidents/fatalities, with the fact that the fire-associated fatalities had COHb and CN' at levels high enough to produce some degree of impairment/toxicity. Furthermore, the study confirms that aviation accidents related to in-flight fires and to CO-contaminated interiors are rare.

Author

Toxicology; Carbon Monoxide; Carboxyhemoglobin; Cyanides; Aircraft Accidents; Aerospace Medicine; Toxicity; Blood; Fires

20000029609 Naval General Hospital, Beijing, China

Effects of High Temperature and Noise on Erythrocyte Membrane ATPase Activity in Pilots During Flight

Qin, Shi-zhen, Naval General Hospital, China; Yu, Qi-fu, Naval General Hospital, China; Ma, Gui-xi, Naval General Hospital, China; Hao, Wei-wei, Naval General Hospital, China; Li, ming-gao, Naval General Hospital, China; Zhao, Hong, Naval General Hospital, China; Space Medicine and Medical Engineering; December 1999; ISSN 1002-0837; Volume 12, No. 6, pp. 397-400; In English; Copyright; Avail: Issuing Activity

The objective of this study was to determine the effect of heat and noise on erythrocyte membrane ATPase activities in pilots during flying. Twenty-four pilots performing bombing for 3 h (45 to about 53 C, 122 to about 97dB in the cabin) served as the subjects. 21 ground personnel served as control (27 C in the room). Blood samples were taken from both groups before flying (6:00 a. m.), and immediately (12:00 a. m.) and 8 h (8:00 p.m.) after flying. Na⁺ - K⁺ ATPase, and Ca(2+) - Mg(2+) ATPase activities in erythrocyte membrane were determined with colorimetry. The Na⁺ - K⁺ ATPase activity in erythrocyte membrane at 6:00 a.m. in the pilots was higher than that in the control group at the same time (Pis less than 0.01). The Ca(2+) - Mg(2+) ATPase

activities in erythrocyte membrane at 12:00 a.m. and 8:00 p. m. in pilots were significantly higher, compared with those in control group at the same time (P is less than 0.01). The ATPase values obtained in our study were all within normal range, and the daytime variation of both groups are the same. Exposure of human body to heat and noise for long time may be harmful, the higher ATPase activity there is, the more there will be catabolism of ATP. ATP exhaustion will lead to Ca^{2+} overload in erythrocytes thus stiffen the red cell membrane.

Author

Adenosine Triphosphate; Enzyme Activity; Erythrocytes; High Temperature; Temperature Effects; Noise (Sound); Flight Hazards

20000032403 Ryerson Polytechnic Univ., Dept. of Mechanical Engineering, Toronto, Ontario Canada

Effect of High +Gz Accelerations on the Left Ventricle

Behdinan, K., Ryerson Polytechnic Univ., Canada; Tabarrock, B., Victoria Univ., Canada; Fraser, W. D., Defence and Civil Inst. of Environmental Medicine, Canada; Models for Aircrew Safety Assessment: Uses, Limitations and Requirements; August 1999, pp. 15-1 - 15-9; In English; See also 20000032388; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

During certain maneuvers, fighter pilots are subjected to high accelerations reaching 10g levels. The effect of this acceleration on the left ventricle is most severe when it is directed along the body z axis. Under such accelerations it is difficult for the heart to function and supply the body with blood and further more there is concern that the heart may suffer tissue tear as a result of high stresses on the heart tissue. In this study a detailed finite element analysis is carried out to determine the stress state of the left ventricle under high Gz loading. to develop the FE model, surface geometry data was acquired from view Point Data Lab in Utah. The surface data for the interior and the exterior of the left ventricle was then used with a software from XYZ Scientific Application Inc. of Livermore to develop a 3D FE model. The model is made up of 3830 solid elements with three layers between the inner and the outer surfaces. Finite element results for deflections, strains and stresses are obtained for a number of acceleration levels. The analysis accounts for geometric nonlinearities and uses the updated Lagrangian method in the MARC finite element program.

Author

Finite Element Method; Heart Function; Gravitational Effects; Human Body; Biological Models (Mathematics); Physiological Responses; Stress (Physiology); Aircraft Maneuvers

20000032404 Defence and Civil Inst. of Environmental Medicine, Toronto, Ontario Canada

A Model of Cerebral Blood Flow During Sustained Acceleration

Cirovic, S., Toronto Univ., Canada; Walsh, C., Ryerson Polytechnic Univ., Canada; Fraser, W. D., Defence and Civil Inst. of Environmental Medicine, Canada; Models for Aircrew Safety Assessment: Uses, Limitations and Requirements; August 1999, pp. 16-1 - 16-7; In English; See also 20000032388

Report No.(s): DCIEM-98-P-XX; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Radial accelerations generated in modern combat aircraft maneuvers (Gz) may result in impaired vision or loss of consciousness (G-LOC). We are interested in developing mathematical models of cerebral blood flow during exposure to Gz. Our previous model showed that intracranial vascular resistance does not change with Gz since the vessels are protected from collapse by the cerebrospinal fluid and that reduction of the blood flow to the brain is mainly due to the increased vascular resistance of the large extracranial veins. Based on the previous results, we propose a model with simplified presentation of the arteries and intracranial vessels and a more detailed description of the jugular veins. The extracranial arteries are accounted for by the hydrostatic pressure drop from the heart to the head level. The intracranial vessels are represented by a resistance independent of the mechanical effects of Gz. However, a model of cerebral autoregulation is incorporated, which involves active change in the cranial vascular resistance in reaction to the change in blood pressure at the head level. The jugular veins are modeled using one dimensional equations of fluid dynamics and a non-linear relation between the transmural (blood minus external) pressure and the local vessel cross-sectional area. The central arterial and venous pressures are taken to be 105 mmHg and 5 mmHg respectively and Gz was varied from -5 to +10, to simulate the effects of positive pressure breathing, blood pressures at the arterial and venous ends of the model were elevated by the same amount, so that the perfusion pressure was always maintained at 100 mmHg. The model is successful in reproducing the drop in cerebral blood flow with +Gz. This reinforces our belief that the elevated venous resistance plays a significant role in G-LOC. The autoregulation has a positive impact at moderate +Gz but is ineffective at higher +Gz. This is mainly due to the fact that the venous resistance becomes absolutely dominant at high +Gz and a further decrease in the cranial vascular resistance makes little difference. The model predicts an increase in the blood flow in the case when the central venous and arterial pressures are elevated. We attribute this to the fact that an elevated central venous pressure prevents the venous collapse and maintains the extracranial veins patent.

Author

Mathematical Models; Acceleration Stresses (Physiology); Aircraft Maneuvers; Blood Flow; Blood Pressure; Brain Circulation; Cardiovascular System

20000032687 Flugmedizinisches Inst. der Luftwaffe, Fuerstenfeldbruck, Germany
Physiological Consequences: Cardiopulmonary, Vestibular, and Sensory Aspects

Welsch, H., Flugmedizinisches Inst. der Luftwaffe, Germany; Alberly, W., Air Force Research Lab., USA; Banks, R. D., Biodynamic Research Corp., USA; Bles, W., Institute for Human Factors TNO, Netherlands; Human Consequences of Agile Aircraft; March 2000, pp. 4 - 1 - 4 - 8; In English; See also 20000032683; Copyright Waived; Avail: CASI; A02, Hardcopy

Discussing the physiological consequences of enhanced fighter maneuverability (EFM), aspects of cardiopulmonary reactions will be seen during high G maneuvers, especially the combination of negative G-load followed by high G-onset maneuvers ("push-pull"). The aircrafts' capability to reach high altitude within a very short time (due to the lift to weight ratio of more than 1) may produce new problems even during normal aircraft operation, e.g. decompression sickness (DCS). The incidence of vestibular problems may be increased by unconventional acceleration exposures. Sensory stimulations may be induced by high acceleration alterations in the roll, pitch, and yaw axis. The support by an advanced G-protection garment will be needed. For the "care free" handling the advanced G-protection device must work without any delay in time even during high acceleration transitions, must secondly include high altitude protection, and thirdly must ensure pilot comfort. Furthermore special training devices are required such as the human centrifuge as a dynamic flight simulator (DFS) with a fully gimballed system, and a spatial (dis)orientation device with a fully three-axes gimballed system. Pilot selection and medical survey with high sophisticated diagnostic tools will become more and more important. Last not least the need of special physical training will be required to power, to train the cardiovascular reflexes, and to increase psychomotoric stability and mental mobility.

Author

Physiological Effects; Aircraft Maneuvers; Flight Characteristics; Flight Fatigue; Human Factors Engineering; Human Centrifuges; Gravitational Effects; Aircraft Pilots; Pilot Performance

20000031947 Army Aeromedical Research Lab., Fort Rucker, AL USA

Spatial Disorientation Demonstration Flight for U.S. Army Aviators in the TH-67, UH-1, and UH-60 Helicopters *Final Report*

Estrada, Arthur; Braithwaite, Malcolm G.; Hoffman, Siobhan M.; LeDuc, Patricia A.; Jan. 2000; 71p; In English
Report No.(s): AD-A373633; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Spatial disorientation (SD) occurs when a pilot misperceives the position, motion, or attitude of his or her aircraft. In wartime, the risk of SD is heightened by the extra pressure on sensory and cognitive resources. During Operation Desert Shield/Storm, 81 percent of U.S. Army aviation nighttime accidents were ascribed to SD. An important countermeasure to SD is the aviator's awareness of his physiological vulnerability to SD and the circumstances in which SD is most likely to occur. Consequently, all military aviators must attend courses of instruction in SD. Most student pilots are given instruction during their flight training on how to overcome the effects of SD, but few air services provide a specific SD demonstration sortie to augment ground-based training. An in-flight demonstration of SD reinforces knowledge of the limitations of the orientation senses in flight and enhances aircrew awareness of potentially disorientating situations. Due to anticipated funding and asset changes at the U.S. Army Aviation Center (USAAVNC), Fort Rucker, Alabama, flight training may be affected and undergo revision. In an effort to be responsive to future training requirements and as the developer of this SD flight training, USAARL is publishing this report containing the SD demonstration flight lesson plans for the TH-67, UH-1, and UH-60 helicopters.

DTIC

Disorientation; Spatial Distribution; UH-1 Helicopter; UH-60A Helicopter; Aircraft Pilots; Sensory Perception

20000032299 North Carolina Agricultural and Technical State Univ., Greensboro, NC USA

Effects of Personality and Gender on a Simulated Flight Task

Strickland, D., North Carolina Agricultural and Technical State Univ., USA; Johnson-Dunnings, H., North Carolina Agricultural and Technical State Univ., USA; Wright, S., North Carolina Agricultural and Technical State Univ., USA; Ntuen, C., North Carolina Agricultural and Technical State Univ., USA; Portalatin, M., North Carolina Agricultural and Technical State Univ., USA; NASA University Research Centers Technical Advances in Aeronautics, Space Sciences and Technology, Earth Systems Sciences, Global Hydrology, and Education; Feb. 22, 1998; Volumes 2 and 3, pp. 263-268; In English; See also 20000032189
Report No.(s): 98URC048; No Copyright; Avail: CASI; A02, Hardcopy; A10, Microfiche; C01, CD-ROM

Traditionally, studies in the area of human factors and supervisory control have focused on the perception and cognitive aspects of the controller in the system. This research was conducted to determine possible effects of personality and gender on an individual's ability to respond to the system, as well as the individual's perception of workload. For this study, a flight simulation prototype with five separate gauges was created to act as the system. Potential participants between the ages of 17 and 30 were given questionnaires to determine whether they were one of the following personality types: Introvert/Extroverts or Type A/Type B. Based on their responses to the questionnaires, five individuals of each personality type were chosen to participate

in the testing (10 males and 10 females). They were exposed to two 30 minute simulated flight sessions, during which time they monitored the gauges for automation failure. Response times to failures were collected and analyzed using analysis of variance. Each participant also filled out workload surveys to determine his/her perceived workload for each session. Statistical analysis indicated significant differences (at an alpha level of 0.05) in response times and workload measures based on gender and personality, as well as the interaction of the two variables. Further research using more subjects is recommended to validate results obtained. Validation may lead to changes in pilot training programs.

Author

Flight Simulation; Human Factors Engineering; Personality; Females; Males; Flight Crews

20000032686 Institut de Medicine Aerospatiale Armee, Dept. Sciences Cognitives, Bretigny sur Orge, France

Psychological Consequences and Pilot "Situational Awareness" Survey

Grau, J. Y., Institut de Medicine Aerospatiale Armee, France; Human Consequences of Agile Aircraft; March 2000, pp. 3 - 1 - 3 - 15; In English; See also 20000032683; Copyright Waived; Avail: CASI; A03, Hardcopy

The technological design and developments already applied to a number of aircraft, which represent the basis of tomorrow's aircraft, tend to change the tasks performed by pilots. Since the 80's, automation and computerization have invaded cockpits, leading to a change in the role of pilots. Whereas pilots used to need competencies directed towards handling and navigating the aircraft, what is now increasingly required of them is the ability to manage complex systems. With the arrival of new concepts like supermaneuverability and superagility, it seems extremely important to try and understand the psychological consequences these concepts will have on pilots. Enabling new types of operation, supermaneuverability and superagility alter existing tasks and will probably create new ones, which will have their own psychological constraints. What makes these constraints different from those existing on present aircraft, and what consequences could they have on pilot performance? These two questions can be addressed by two preliminary comments: (1) As of today, supermaneuverability and superagility are still extremely novel concepts. Various "prototype" aircraft point to the developments, which will eventually make these concepts a reality in the near future, but there still is no such thing as "real" operational experience. The difficulty in accurately studying the consequences these future aircraft will have on pilots, lies in trying to define the exact role the pilot will be asked to play aboard. (2) The psychological consequences studied in this chapter will be limited to the consequences borne by the pilot in terms of taking and processing information. This chapter does not take into account psychological aspects based on personality or motivation.

Derived from text

Aircraft Pilots; Human-Computer Interface; Pilot Performance; Flight Fatigue; Stress Analysis; Human Factors Engineering

20000032689 Swedish Air Force, Aeromedical Center, Stockholm, Sweden

Selection, Training and Simulation

Linder, Jan, Swedish Air Force, Sweden; Tielemans, W., Swedish Air Force, Sweden; Alberty, W., Swedish Air Force, Sweden; Human Consequences of Agile Aircraft; March 2000, pp. 6 - 1 - 6 - 10; In English; See also 20000032683; Copyright Waived; Avail: CASI; A02, Hardcopy

In this paper a "superagility training structure" has been discussed and proposed. The super agile pilot will in the new superagility arena be clearly dependent on both old training principles but also on training where some new interacting factors might come into play: (1) At first Selection plays a major role with physiological, intellectual and stress management resources; (2) Certain human constraints like musculoskeletal, cardiovascular, respiratory, sensory and mental are discussed; (3) Normal life and regular training where almost everything the pilot does also have a definite implication also on flying; (4) Specific single task training where a pilot trains crucial abilities like G-tolerance, back/neck tolerance and so on. Today there is a lack in this area of specific training. There is also a need for training devices for pilots regarding the sensory system and the cognitive performance; (5) Specific combined tasks training where the pilot have to train in a more complex way, e.g. survival training or mission scenarios in a Multi Mission Trainer (MMT); and (6) Full ground mission task where the pilot uses a Full Mission Simulator (FMS) or a Dynamic Flight Simulator (DFS). Some parts of the Superagility Training Structure have not been a scope of this paper. They are Basic flying and Tactical/operational flying.

Derived from text

Pilot Selection; Physiological Tests; Flight Simulation; Pilot Training; Human Factors Engineering; Flight Fatigue; Flight Stress (Biology); Pilot Performance

20000029553 Institute of Space Medico-Engineering, Beijing, China

Safety Analysis for Astronaut and the Personal Protective Equipment

Chen, Jin-dun, Institute of Space Medico-Engineering, China; Sun, Jin-biao, Institute of Space Medico-Engineering, China; Shi, He-ping, Institute of Space Medico-Engineering, China; Sun, Hai-long, Institute of Space Medico-Engineering, China; Space

Medicine and Medical Engineering; December 1999; ISSN 1002-0837; Volume 12, No. 6, pp. 418-422; In Chinese; Copyright; Avail: Issuing Activity

The objective of this study was to analyze and study astronauts and their personal safety equipment. Three of the most widely used approaches, failure mode and effect analysis (FMEA), fault tree analysis (FTA) and system hazards analysis (SHA) were used. It was demonstrated that astronauts and their personal equipment are subjected to various potential hazards, such as human errors, astronaut illness, fire or space suit emergency decompression, etc. Their causes, mechanisms, possible effects and criticality of some critical potential hazards were analyzed and identified in more details with considerations of the historic accidents of manned spaceflight. The compensating provisions and preventive measures for each hazard were discussed. The analysis study may be helpful in enhancing the astronaut safety and their personal protective equipment.

Author

Astronauts; Space Suits; Aerospace Safety; Flight Safety; Safety Devices

20000032397 Veridian, Systems Analysis and Research, Dayton, OH USA

Continued Development of an Integrated EASY5/ACESII-ATB Model for Ejection Seat Simulation

Ma, Deren, Veridian, USA; Obergefell, Louise A., Air Force Research Lab., USA; Rogers, Lawrence C., Aeronautical Systems Div., USA; Rizer, Annette L., Veridian, USA; Models for Aircrew Safety Assessment: Uses, Limitations and Requirements; August 1999, pp. 9-1 - 9-9; In English; See also 20000032388; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

This paper presents continued development and validation of an integrated ejection/crewmember model, specifically the modeling of aerodynamic effects and the crewmember/seat separation process. In a previous study, an ejection seat model, EASY5/ACESII (Engineering Analysis SYstem/Advanced Concept Ejection Seat), was coupled with a crewmember model, the ATB (Articulated Total Body) model. In this study, newly developed algorithms were incorporated into the integrated model to simulate the aerodynamics and seat/crewmember separation. Wind tunnel data from the ejection seat module are used to obtain total aerodynamic forces on the seat/crewmember combination. The crewmember module then uses an analytical method, based on air pressure and the exposed surface area, to calculate the aerodynamic forces and torques applied to the crewmember's individual body segments. These body forces and torques are then subtracted from the total forces and torques to obtain the force components applied directly to the seat in the ejection seat module. Once the man/seat separation signal is initiated, the aerodynamic forces and torques are applied only to the crew member. Dynamic interaction between the seat and crewmember during the very short period of their separation is complex and critically important. In this study, the harness release and crewmember/seat separation process algorithms were designed and implemented. When the release signal of the harness restraint is generated in the ejection seat module, it is transferred to the crewmember module. The harness belt in the crewmember module is then cut off. Meanwhile, the recovery parachute force from the ejection seat module is sent to the crewmember module. The combined forces due to gravity, recovery parachute, and aerodynamics separate the ejection seat and crewmember. Simulations of F-16/ACESII sled tests were carried out to validate the newly developed features in the integrated model. Simulation results are reported and compared with results of ejection seat sled tests. The validation shows that the model successfully predicts the major features of the ejection seat motion and the crewmember biodynamic responses.

Author

Aerodynamic Forces; Ejection Seats; Escape Systems; Crews; Torque; Computerized Simulation; Mathematical Models; Physiological Responses; Biodynamics

20000032398 JAYCOR, San Diego, CA USA

Head Protection Against Windblast for Crew Escape

Chan, Philemon C., JAYCOR, USA; Yu, James H.-Y., JAYCOR, USA; Stuhmiller, James H., JAYCOR, USA; Models for Aircrew Safety Assessment: Uses, Limitations and Requirements; August 1999, pp. 10-1 - 10-15; In English; See also 20000032388

Contract(s)/Grant(s): F41624-95-C-6014; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

A pilot ejecting from an aircraft at high speed faces the possibility of windblast head/neck injury. To establish a phenomenological understanding of windblast protection for the head, three stagnation concepts, the unvented fence, the hood and the brim have been evaluated. As tested in the wind tunnel, the unvented fence and hood produce over stagnation which may subject the head to unwanted oscillations. The vented hood and the brim can reduce the normal head force without over stagnation, but with a significant increase of side head force. The side head force increase is caused by windward headrest flow stagnation,

as confirmed by computational fluid dynamics simulations and subscale water tunnel model testing. Studies were performed to reduce the head rest flow stagnation using the open brim concept.

Author

Head (Anatomy); Blasts; Ejection Injuries; Escape Systems; Safety Devices; Neck (Anatomy); Protection; Water Tunnel Tests; Scale Models

20000032688 Air Force Research Lab., HECF, Wright-Patterson AFB, OH USA

Pilot-Vehicle Interface

Calhoun, G. L., Air Force Research Lab., USA; Human Consequences of Agile Aircraft; March 2000, pp. 5 - 1 - 5 - 20; In English; See also 20000032683; Copyright Waived; Avail: CASI; A03, Hardcopy

Agile aircraft introduce new requirements and performance standards for the pilot-vehicle interface. This lecture will address these ergonomic issues as they pertain to agile aircraft. Specifically, controls and displays will be discussed, followed by design issues relevant to intelligent interfaces. The concepts and technologies proposed as candidate solutions for creating pilot-vehicle synergy are, for the most part, untested at present. It is hoped that this lecture will provide the impetus for the research required to realize a pilot-vehicle interface that will enhance the operation of agile aircraft, new capabilities, it is the multitude of systems that constitute agile aircraft that make the pilots' information management task the primary challenge and key determinant of successful deployment. Crew station design with the goal of pilot-cockpit synergy has the potential to provide the flexibility to maximum mission effectiveness.

Author

Human Factors Engineering; Flight Characteristics; Aircraft Pilots; Flight Fatigue; Flight Control; Display Devices; Flight Stress (Biology); Human-Computer Interface

15

MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

Includes general topics and overviews related to mathematics and computer science.

20000027425 Technion - Israel Inst. of Tech., Haifa, Israel

Computer-Assisted Planning of an Aerobatic Sequence

Iosilevskii, G., Technion - Israel Inst. of Tech., Israel; Shafir, Y., Elbit Systems Ltd., Israel; 1999 Report to the Aerospace Profession: Forty Third Symposium Proceedings; September 1999, pp. 145-153; In English; See also 20000027414; Copyright; Avail: Issuing Activity

This paper discusses considerations developed by the Air Force Flight Test Center test system safety process for assessing the risk associated with testing ground collision avoidance systems (GCAS). It specifically discusses available reaction time (A.R.T.) as a tool used to assess the risk of test points flown by the F-16 Combined Test Force at Edwards Air Force Base, California, during Digital Terrain System (DTS) developmental test and evaluation. The A.R.T. system uses time to ground impact as a normalizing factor to define the risk associated with flying any given GCAS test point. The numerous risk factors associated with GCAS testing and the necessary assumptions required to conduct such testing safely are also discussed. The initial results of the DTS testing that affected the A.R.T. based risk assessment are presented along with how the risk assessment was changed based on the lessons learned about pilot reaction times and pilot comfort level. Overall, the paper emphasizes basic principles that apply to conducting GCAS testing in any type of aircraft from fighters to transports.

Derived from text

Computer Techniques; Planning; Sequencing; Aerobatics; Flight Control; Maneuvers; Flight Tests; Risk; Assessments

20000032868 NASA Lewis Research Center, Cleveland, OH USA

Rotorcraft Damage Tolerance Evaluated by Computational Simulation

Chamis, Christos C., NASA Lewis Research Center, USA; Minnetyan, Levon, Clarkson Univ., USA; Abdi, Frank, Alpha Star Corp., USA; Application of Damage Tolerance Principles for Improved Airworthiness of Rotorcraft; February 2000, pp. 12 - 1 - 12 - 13; In English; See also 20000032859; Copyright Waived; Avail: CASI; A03, Hardcopy

An integrally stiffened graphite/epoxy composite rotorcraft structure is evaluated via computational simulation. A computer code that scales up constituent micromechanics level material properties to the structure level and accounts for all possible failure

modes is used for the simulation of composite degradation under loading. Damage initiation, growth, accumulation, and propagation to fracture are included in the simulation. Design implications with regard to defect and damage tolerance of integrally stiffened composite structures are examined. A procedure is outlined regarding the use of this type of information for setting quality acceptance criteria, design allowables, damage tolerance, and retirement-for-cause criteria.

Author

Composite Structures; Crack Initiation; Cylindrical Shells; Damage; Simulation; Tolerances (Mechanics); Graphite-Epoxy Composites; Rotary Wing Aircraft; Computer Programs; Failure Modes; Micromechanics

20000032291 California State Univ., Dept. of Mechanical Engineering, Los Angeles, CA USA

Development of Multi-Disciplinary Finite Element Method Analysis Courses at California State University, Los Angeles
McKinney, John, California State Univ., USA; Wu, Chivey, California State Univ., USA; NASA University Research Centers Technical Advances in Aeronautics, Space Sciences and Technology, Earth Systems Sciences, Global Hydrology, and Education; Feb. 22, 1998; Volumes 2 and 3, pp. 789-794; In English; See also 20000032189

Report No.(s): 98URC141; No Copyright; Avail: CASI; A02, Hardcopy; A10, Microfiche; C01, CD-ROM

The NASA Dryden Flight Research Center (DFRC) Partnership Awards Grant to California State University, Los Angeles (CSULA) has two primary goals that help to achieve NASA objectives. The overall objectives of the NASA Partnership Awards are to create opportunities for joint University NASA/Government sponsored research and related activities. One of the goals of the grant is to have university faculty researchers participate and contribute to the development of NASA technology that supports NASA goals for research and development (R&D) in Aeronautics and Astronautics. The other goal is technology transfer in the other direction, where NASA developed technology is made available to the general public and more specifically, targeted to industries that can profit from utilization of government developed technology. This years NASA Dryden Partnership Awards grant to CSULA entitled, "Computer Simulation of Multi-Disciplinary Engineering Systems", has two major tasks that satisfy overall NASA objectives. The first task conducts basic and applied research that contributes to technology development at the Dryden Flight Research Center. The second part of the grant provides for dissemination of NASA developed technology, by using the teaching environment created in the CSULA classroom. The second task and how this is accomplished is the topic of this paper. The NASA STARS (Structural Analysis Routines) computer simulation program is used at the Dryden center to support flight testing of high-performance experimental aircraft and to conduct research and development of new and advanced Aerospace technology.

Derived from text

Finite Element Method; Multidisciplinary Research; Computerized Simulation; Systems Engineering; NASA Programs; Aeronautics

20000033701 Institute for Computer Applications in Science and Engineering, Hampton, VA USA

Parallel performance investigations of an unstructured mesh Navier-Stokes solver *Final Report*

Mavriplis, Dimitri J., Institute for Computer Applications in Science and Engineering, USA; March 2000; 46p; In English

Contract(s)/Grant(s): NAS1-97046; B347882; AF-AFOSR-0005-99; RTOP 505-90-52-01

Report No.(s): NASA/CR-2000-210088; NAS 1.26:210088; ICASE-2000-13; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A Reynolds-averaged Navier-Stokes solver based on unstructured mesh techniques for analysis of high-lift configurations is described. The method makes use of an agglomeration multigrid solver for convergence acceleration. Implicit line-smoothing is employed to relieve the stiffness associated with highly stretched meshes. A GMRES technique is also implemented to speed convergence at the expense of additional memory usage. The solver is cache efficient and fully vectorizable, and is parallelized using a two-level hybrid MPI-OpenMP implementation suitable for shared and/or distributed memory architectures, as well as clusters of shared memory machines. Convergence and scalability results are illustrated for various high-lift cases.

Author

Navier-Stokes Equation; Unstructured Grids (Mathematics); Multigrid Methods; Reynolds Averaging; Parallel Processing (Computers); Aerodynamic Configurations; Finite Volume Method

16
PHYSICS (GENERAL)

Includes general research topics related to mechanics, kinetics, magnetism, and electrodynamics.

20000027442 NASA Ames Research Center, Moffett Field, CA USA

Sonic Boom Prediction Exercise: Experimental Comparisons

Tu, Eugene, NASA Ames Research Center, USA; Cheung, Samson, MCAT Inst., USA; Edwards, Thomas, NASA Ames Research Center, USA; High-Speed Research: 1994 Sonic Boom Workshop. Configuration, Design, Analysis and Testing; December 1999, pp. 13-32; In English; See also 20000027440; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

The success of a future High Speed Civil Transport (HSCT) depends on the ability to accurately assess and, possibly, modify the sonic boom signatures of potential designs. In 1992, the Sonic Boom Steering Committee initiated a prediction exercise to assess the current computational capabilities for the accurate and efficient prediction of sonic boom signatures and loudness levels. A progress report of this effort was given at the Sonic Boom Workshop held at NASA Ames Research Center in 1993 where predictions from CFD and Modified Linear Theory (MLT) methods were given. Comparisons between the methods were made at near-, mid- and far-field locations. However, at that time, experimental data from wind-tunnel tests were not available. The current paper presents a comparison of computational results with the now available experimental data. Further comparisons between the computational methods and analyses of the discrepancies in the results are presented.

Author

Sonic Booms; Supersonic Transports; Aerodynamic Noise; Prediction Analysis Techniques

20000027443 NASA Ames Research Center, Moffett Field, CA USA

Design and Computational/Experimental Analysis of Low Sonic Boom Configurations

Cliff, Susan E., NASA Ames Research Center, USA; Baker, Timothy J., Princeton Univ., USA; Hicks, Raymond M., NASA Ames Research Center, USA; High-Speed Research: 1994 Sonic Boom Workshop. Configuration, Design, Analysis and Testing; December 1999, pp. 33-58; In English; See also 20000027440; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Recent studies have shown that inviscid CFD codes combined with a planar extrapolation method give accurate sonic boom pressure signatures at distances greater than one body length from supersonic configurations if either adapted grids swept at the approximate Mach angle or very dense non-adapted grids are used. The validation of CFD for computing sonic boom pressure signatures provided the confidence needed to undertake the design of new supersonic transport configurations with low sonic boom characteristics. An aircraft synthesis code in combination with CFD and an extrapolation method were used to close the design. The principal configuration of this study is designated LBWT (Low Boom Wing Tail) and has a highly swept cranked arrow wing with conventional tails, and was designed to accommodate either 3 or 4 engines. The complete configuration including nacelles and boundary layer diverters was evaluated using the AIRPLANE code. This computer program solves the Euler equations on an unstructured tetrahedral mesh. Computations and wind tunnel data for the LBWT and two other low boom configurations designed at NASA Ames Research Center are presented. The two additional configurations are included to provide a basis for comparing the performance and sonic boom level of the LBWT with contemporary low boom designs and to give a broader experiment/CFD correlation study. The computational pressure signatures for the three configurations are contrasted with on-ground-track near-field experimental data from the NASA Ames 9x7 Foot Supersonic Wind Tunnel. Computed pressure signatures for the LBWT are also compared with experiment at approximately 15 degrees off ground track.

Author

Computational Fluid Dynamics; Sonic Booms; Supersonic Transports; Nacelles; Pressure Distribution; Computational Grids; Wind Tunnel Tests; Inviscid Flow; Computer Programs; Bow Waves

20000027445 Boeing Commercial Airplane Co., Seattle, WA USA

Low Sonic Boom Design Activities at Boeing

Haglund, George T., Boeing Commercial Airplane Co., USA; High-Speed Research: 1994 Sonic Boom Workshop. Configuration, Design, Analysis and Testing; December 1999, pp. 73-87; In English; See also 20000027440
Contract(s)/Grant(s): NAS1-19360; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Low sonic boom studies have continued during the last year with the goal of exploring the ability of practical airplane designs to achieve significantly reduced sonic boom-loudness with reasonable performance penalties. At the 1993 Sonic Boom Workshop, improvements to the low-boom design methods were described and early results of two low-boom configurations -935 and -936) were presented. Now that the low boom design methods are reasonably mature, recent design activities have broadened somewhat to explore refinements to the -935 and -936 designs. In this paper the results are reported of a detailed systems study and performance sizing of the -935 (Hybrid sonic boom waveform) and the -936 (Flat-top waveform). This analysis included a second

design cycle for reduced cruise drag and balance considerations. Another design study was of a small-wing version of the -935. Finally, some preliminary results of the recent LARC UPWT test of the -935 configuration are given, along with a proposed alternative method for extrapolating wind tunnel pressure signatures to the ground. The various configurations studied is also summarized. The topics covered by this paper are as follows: Systems study results of the Baseline -939 and low boom configurations -935 and -936, Small wing derivative of the -935, Wind tunnel test results of the -935, Test-derived F-function and propagation to the ground, and Future considerations (boom-softened baseline, overwater issues, and operations).

Author

Sonic Booms; Aerodynamic Configurations; Aircraft Design; Waveforms; Wings; Aerodynamic Noise

20000027446 MCAT Inst., Moffett Field, CA USA

Sonic Boom Softening of Reference-H

Cheung, Samson, MCAT Inst., USA; High-Speed Research: 1994 Sonic Boom Workshop. Configuration, Design, Analysis and Testing; December 1999, pp. 89-106; In English; See also 20000027440; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

For the past four years, various low-boom configurations have been designed and tested in wind tunnels. However, recent consideration of high speed civil transport (HSCT) flying over water reveals the possibility of a high performance aircraft flying within a specific corridor. Boeing's Reference-H, which is a performance aircraft cruising at Mach 2.4 over-water, is considered as a baseline configuration for the HSCT. Typically, a performance aircraft has higher lift coefficient than a low-boom configuration. It is known to the industry that it is difficult to reduce the sonic boom of a performance aircraft to the noise level of a low-boom aircraft. In the present study, effort was spent to find out what factors make the reduction of loudness level of a performance aircraft so difficult, and to investigate the possibility of reducing the loudness level of Reference-H.

Author

Sonic Booms; Supersonic Transports; Aircraft Design; Aerodynamic Noise; Aircraft Configurations; Noise Intensity; Aerodynamic Coefficients; Aircraft Structures

20000027447 Northrop Grumman Corp., Research and Development Center, Bethpage, NY USA

The Analysis and Design of Low Boom Configurations Using CFD and Numerical Optimization Techniques

Siclari, Michael J., Northrop Grumman Corp., USA; High-Speed Research: 1994 Sonic Boom Workshop. Configuration, Design, Analysis and Testing; December 1999, pp. 107-128; In English; See also 20000027440; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

The use of computational fluid dynamics (CFD) for the analysis of sonic booms generated by aircraft has been shown to increase the accuracy and reliability of predictions. CFD takes into account important three-dimensional and nonlinear effects that are generally neglected by modified linear theory (MLT) methods. Up to the present time, CFD methods have been primarily used for analysis or prediction. Some investigators have used CFD to impact the design of low boom configurations using trial and error methods. One investigator developed a hybrid design method using a combination of Modified Linear Theory (e.g. F-functions) and CFD to provide equivalent area due to lift driven by a numerical optimizer to redesign or modify an existing configuration to achieve a shaped sonic boom signature. A three-dimensional design methodology has not yet been developed that completely uses nonlinear methods or CFD. Constrained numerical optimization techniques have existed for some time. Many of these methods use gradients to search for the minimum of a specified objective function subject to a variety of design variable bounds, linear and nonlinear constraints. Gradient based design optimization methods require the determination of the objective function gradients with respect to each of the design variables. These optimization methods are efficient and work well if the gradients can be obtained analytically. If analytical gradients are not available, the objective gradients or derivatives with respect to the design variables must be obtained numerically. to obtain numerical gradients, say, for 10 design variables, might require anywhere from 10 to 20 objective function evaluations. Typically, 5-10 global iterations of the optimizer are required to minimize the objective function. In terms of using CFD as a design optimization tool, the numerical evaluation of gradients can require anywhere from 100 to 200 CFD computations per design for only 10 design variables. If one CFD computation requires an hour of computational time on a Cray computer, one can see that the use of constrained numerical optimization quickly becomes impractical. Hence, in order to practically couple a numerical design optimization technique with a CFD method, the CFD method must be extremely efficient with running times on the order of only minutes. The CFD Euler code developed under NASA sponsorship and referred to as MIM3D-SB for the most part fulfills these efficiency requirements. Analysis of wing- body configurations can be computed in a matter of a few minutes. The present study will concentrate on the feasibility of the use of this CFD code in conjunction with a numerical design optimization technique for the sonic boom reduction of candidate HSCT configurations. A preliminary supersonic aircraft design system has been established that utilizes the numerical design optimization code NPSOL developed at Stanford University coupled with the supersonic NUM3D-SB CFD code. Many questions still need to be answered in regard

to using CFD and numerical optimizers as design tools. There are difficulties related to both the CFD codes and the numerical optimizers. Numerical optimizers can converge to a local minima rather than a global minima. This behavior is largely a function of the initial guess in the design space. The optimizer also is searching for a minimum of the function in terms of its derivative without any regard to the actual function value. Numerically (i.e. CFD) determined gradients can also generate spurious numerical local minima. In addition, for the sonic boom problem, grid fineness will also determine the accuracy of the final design solution. Design optimization methods work well on problems defined by continuous objective functions. The sonic boom signature design problem is not necessarily defined by a continuous objective function. The signature can have a variety of shapes; i.e. from N-wave to multiple shocks. The far-field or ground signature may not transition continuously from one shape to another and hence, may exhibit discontinuous behavior. This is also a source of difficulty in using design optimization methods. In the following sections, several low boom and one reference aircraft configuration will be analyzed to predict their sonic boom signature characteristics. Modifications to some of these designs will also be presented to demonstrate the feasibility of using CFD as a design tool and to demonstrate the feasibility of designing shaped sonic boom signatures. Design modifications to some configurations will be presented to demonstrate the feasibility of achieving shaped signatures with reduced levels and not necessarily to represent realistic or aerodynamically efficient design modifications. Fuselage volume or camber are used as design variables in order to have a minimal effect on the primary wing aerodynamics. The paper will also seek to demonstrate whether a hybrid or ramped signature is feasible to achieve. For the low-boom configurations, the CFD predicted signatures will be compared qualitatively to their MLT design signatures.

Derived from text

Sonic Booms; Supersonic Transports; Aircraft Configurations; Computational Fluid Dynamics; Aircraft Design; Aircraft Structures; Aerodynamic Noise

20000027448 NASA Ames Research Center, Moffett Field, CA USA

Mid-Field Sonic Boom Extrapolation Methodology

Cheung, Samson, NASA Ames Research Center, USA; Davis, Sanford, NASA Ames Research Center, USA; Tu, Eugene, NASA Ames Research Center, USA; High-Speed Research: 1994 Sonic Boom Workshop. Configuration, Design, Analysis and Testing; December 1999, pp. 129-148; In English; See also 20000027440; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

In the design cycle of low-boom airplanes, sonic boom prediction must be accurate and efficient. The classical linear method, Whitham's F-function theory, has been widely applied to predict sonic boom signatures. However, linear theory fails to capture the nonlinear effects created by large civil transport. Computational fluid dynamics (CFD) has been used successfully to predict sonic boom signals at the near and mid fields. Nevertheless, it is computationally expansive in airplane design runs. In the present study, the method of characteristics is used to predict sonic boom signals in an efficient fashion. The governing equations are the axisymmetric Euler's equations with constant enthalpy. Since the method solves Euler's equations, it captures more nonlinear effects than the classical Whitham's F-function technique. Furthermore, the method of characteristics is an efficient marching scheme for initial value problems. In this study, we will first review the current CFD extrapolation technique and the work previously done in sonic boom extrapolation. Then, we will introduce the governing equations and the method of characteristics. Finally, we will show that the present method yields the same accurate results as previous CFD techniques, but with higher efficiency.

Author

Sonic Booms; Aircraft Design; Computational Fluid Dynamics; Method of Characteristics; Euler Equations of Motion; Aircraft Configurations; Aircraft Structures

20000027451 McDonnell-Douglas Aerospace, Long Beach, CA USA

SR-71A Reduced Sonic Boom Modification Design

Morgenstern, John M., McDonnell-Douglas Aerospace, USA; Bruns, David B., McDonnell-Douglas Aerospace, USA; Camacho, Peter P., McDonnell-Douglas Aerospace, USA; High-Speed Research: 1994 Sonic Boom Workshop. Configuration, Design, Analysis and Testing; December 1999, pp. 199-217; In English; See also 20000027440; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

The adverse impact of sonic booms stems from the loudness and startle they produce. It is desirable, for future generation supersonic transport studies, to develop technology for reduced sonic boom environmental impact and possibly enhance operational economics. Previous sonic boom reduction studies developed sonic boom waveform shaping as a method for reducing loudness. The shape of the waveform is altered by tailoring the distribution of lift and volume of the vehicle, generating a waveform shape that does not evolve into an 'N' wave when it reaches the ground. Waveform shaping has been validated in wind tunnel tests, demonstrating that waveform shaping can be achieved up to several body lengths from a vehicle in a uniform atmosphere. Sonic boom propagation theory has been developed to predict how the sonic boom waveform evolves as it travels

to the ground in the real atmosphere, without winds, atmospheric turbulence, or finite rise time calculation. This propagation theory has been validated for 'N' wave sonic booms under calm atmospheric conditions, and predicts the mean loudness well for the more random waveforms obtained under unsteady atmospheric conditions. An investigation was undertaken by McDonnell Douglas, under NASA funding, to determine if a flight experiment could be developed to: demonstrate the propagation of shaped sonic boom waveforms through a real atmosphere, and obtain an indication of the effects of turbulence on sonic boom shaping. This investigation led to the conclusion that an SR-71A was a suitable vehicle for further waveform shaping studies. A very rough analysis developed a preliminary modification, consisting of only volume additions, that appeared to make the experiment feasible. More detailed studies were then undertaken to validate methods and refine the design. In-flight data was obtained for the unmodified SR-71A to validate sonic boom predictions in the near-field of the SR-71A. An F-16XL flew several passes 100 to 500 feet under the SR-71A to measure the SR-71A waveform pressure distribution at the design condition of Mach 1.8. McDonnell Douglas Euler CFD calculations linked with propagation codes predicted the pressures under the SR-71A. The CFD propagation method was then used for modification design analysis and the shape of the modification was finalized through an iterative design approach.

Derived from text

Sonic Booms; Supersonic Transports; Waveforms; Noise Reduction; Aircraft Design; Aerodynamic Configurations; Turbulence Effects; Flight Tests; SR-71 Aircraft

20000027452 Lockheed Engineering and Sciences Co., Hampton, VA USA

CFD Predictions of Sonic-Boom Characteristics for Unmodified and Modified SR-71 Configurations

Fouladi, Kamran, Lockheed Engineering and Sciences Co., USA; High-Speed Research: 1994 Sonic Boom Workshop. Configuration, Design, Analysis and Testing; December 1999, pp. 219-235; In English; See also 20000027440

Contract(s)/Grant(s): NAS1-19000; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Shaped sonic-boom signatures refer to signatures that look something other than the typical N-waves. Shaped sonic-boom signatures such as "flat-top," "ramp-type," or "hybrid-type" waveforms have been shown to reduce the subjective loudness without requiring reductions in overpressure peaks. The shaping of sonic-boom signatures requires increasing the shock rise time and changes in frequency spectra. So far, a flat-top waveform was shown to be achievable in wind tunnels; however, the influence of long propagation distance and real atmosphere on shaped signatures should be addressed using flight tests. Two different approaches have been proposed for sonic-boom minimization flight tests. The first approach, proposed by Eagle Aerospace, is for a flight test using a modified BQM-34 "FIREBEE" remotely piloted vehicle. The 30-foot long FIREBEE has a steady state flight condition at the Mach number and altitude of interest, and it can be recovered by helicopter from the water. As an alternative approach, a modified SR-71 vehicle has been proposed by the McDonnell Douglas Corporation. Benefits of the SR-71 include its variable geometry supersonic inlets, small cockpit bulge, higher Mach number capabilities, slender design, and longer length (105 foot). The present investigation addresses the sonic-boom analysis for the second vehicle. The objective of the current investigation is to assess the feasibility of a modified SR-71 configuration, with McDonnell Douglas-designed fuselage modifications, intended to produce shaped sonic-boom signatures on the ground. The present study describes the use of a higher-order computational fluid dynamics (CFD) method to predict the sonic-boom characteristics for both unmodified and modified SR-71 configurations. An Euler unstructured grid methodology is used to predict the near-field, three-dimensional pressure patterns generated by both SR-71 models. The computed near-field pressure signatures are extrapolated to specified distances below the aircraft down to impingement on the ground using the code MDBOOM. Comparisons of the near-field pressure signatures with available flight-test data are presented in the current paper.

Derived from text

Sonic Booms; SR-71 Aircraft; Aircraft Design; Aircraft Structures; Noise Reduction; Computational Fluid Dynamics; Waveforms; Supersonic Inlets; Unstructured Grids (Mathematics)

20000027454 NASA Johnson Space Center, Houston, TX USA

In-Flight Technique for Acquiring Mid- and Far-Field Sonic Boom Signatures

Stansbery, Eugene G., NASA Johnson Space Center, USA; Baize, Daniel G., NASA Langley Research Center, USA; Maglieri, Domenic, J., Eagle Aerospace, Inc., USA; High-Speed Research: 1994 Sonic Boom Workshop. Configuration, Design, Analysis and Testing; December 1999, pp. 249-268; In English; See also 20000027440; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Flight test experiments have been conducted to establish the feasibility of obtaining sonic boom signature measurements below a supersonic aircraft using the NASA Portable Automatic Triggering System (PATS) mounted in the USMC Pioneer Unmanned Aerial Vehicle (UAV). This study forms a part of the NASA sonic boom minimization activities, specifically the demonstration of persistence of modified boom signatures to very large distances in a real atmosphere. The basic objective of the

measurement effort was to obtain a qualitative view of the sonic boom signature in terms of its shape, number of shocks, their locations, and their relative strength. Results suggest that the technique may very well provide quantitative information relative to mid-field and far-field boom signatures. The purpose of this presentation is to describe the arrangement and operation of this in-flight system and to present the resulting sonic boom measurements. Adaption and modification of two PATS to the UAV payload section are described and include transducer location, mounting arrangement and recording system isolation. Ground static runup, takeoff and landing, and cruise flight checkouts regarding UAV propeller and flow noise on the PATS automated triggering system and recording mode are discussed. For the proof-of-concept tests, the PATS instrumented UAV was flown under radar control in steady-level flight at the altitude of 8700 feet MSL and at a cruise speed of about 60 knots. The USN F-4N sonic boom generating aircraft was vectored over the UAV on reciprocal headings at altitudes of about 11,000 feet MSL and 13,000 feet MSL at about Mach 1.15. Sonic boom signatures were acquired on both PATS for all six supersonic passes. Although the UAV propeller noise is clearly evident in all the measurements, the F-4 boom signature is clearly distinguishable and is typically N-wave in character with sharply rising shock fronts and with a mid-shock associated with the inlet-wing juncture. Consideration is being given to adapting the PATS/TJAV measurements technique to the NASA Learjet to determine feasibility of acquiring in-flight boom signatures in the altitude range of 10,000 feet to 40,000 feet.

Author

Sonic Booms; Flight Tests; Supersonic Aircraft; In-Flight Monitoring; Far Fields; Shock Fronts; Supersonic Flow

20000027455 NASA Langley Research Center, Hampton, VA USA

Progress in Sonic-Boom Understanding: Lessons Learned and Next Steps

Darden, Christine M., NASA Langley Research Center, USA; High-Speed Research: 1994 Sonic Boom Workshop. Configuration, Design, Analysis and Testing; December 1999, pp. 269-292; In English; See also 20000027440; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

In January 1988, representatives from NASA, NOAA, academia, and industry gathered at the NASA Langley Research Center to assess the status of understanding of the sonic boom which accompanies supersonic flight. As a result of that meeting, a research program on sonic boom within the NASA High-Speed Research (HSR) Program was implemented. This paper discusses the elements of the sonic-boom program, progress which has been made since 1988, and the current change in direction for the Sonic-Boom Element of the NASA HSR Program.

Author

Sonic Booms; Supersonic Transports; Aircraft Design; Aircraft Structures; Noise Reduction

20000030676 NASA Langley Research Center, Hampton, VA USA

F-16XL and F-18 High Speed Acoustic Flight Test Databases

Kelly, J. J., Lockheed Martin Engineering and Sciences Co., USA; Wilson, M. R., Lockheed Martin Engineering and Sciences Co., USA; Rawls, J., Jr., Lockheed Martin Engineering and Sciences Co., USA; Norum, T. D., NASA Langley Research Center, USA; Golub, R. A., NASA Langley Research Center, USA; December 1999; 274p; In English
Contract(s)/Grant(s): RTOP 537-09-21-21

Report No.(s): NASA/TM-1999-209529; NAS 1.15:209529; L-17899; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

This report presents the recorded acoustic data and the computed narrow-band and 1/3-octave band spectra produced by F-18 and F-16XL aircraft in subsonic flight over an acoustic array. Both broadband-shock noise and turbulent mixing noise are observed in the spectra. Radar and c-band tracking systems provided the aircraft position which enabled directivity and smear angles from the aircraft to each microphone to be computed. These angles are based on source emission time and thus give some idea about the directivity of the radiated sound field due to jet noise. A follow-on static test was also conducted where acoustic and engine data were obtained. The acoustic data described in the report has application to community noise analysis, noise source characterization and validation of prediction models. A detailed description of the signal processing procedures is provided. Follow-on static tests of each aircraft were also conducted for which engine data and far-field acoustic data are presented.

Author

Flight Tests; F-16 Aircraft; F-18 Aircraft; Data Bases; Data Acquisition; Subsonic Speed; Spectral Bands; Sound Fields; Octaves; Jet Aircraft Noise; Acoustic Properties

20000031362 NASA Langley Research Center, Hampton, VA USA

Modelling Aerodynamically Generated Sound: Recent Advances in Rotor Noise Prediction

Brentner, Kenneth S., NASA Langley Research Center, USA; 2000; 12p; In English; 38th; Aerospace Sciences, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2000-0345; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

A great deal of progress has been made in the modeling of aerodynamically generated sound for rotors over the past decade. The Ffowcs Williams-Hawkings (FW-H) equation has been the foundation for much of the development. Both subsonic and supersonic quadrupole noise formulations have been developed for the prediction of high-speed impulsive noise. In an effort to eliminate the need to compute the quadrupole contribution, the FW-H has also been utilized on permeable surfaces surrounding all physical noise sources. Comparison of the Kirchhoff formulation for moving surfaces with the FW-H equation have shown that the Kirchhoff formulation for moving surfaces can give erroneous results for aeroacoustic problems.

Author

Aerodynamic Noise; Rotor Aerodynamics; Aeroacoustics; Noise Prediction (Aircraft); Aircraft Noise

20000032357 Florida Agricultural and Mechanical Univ., Fluid Mechanics Research Lab., Tallahassee, FL USA

Visualization in a Mach 2 Jet of Mach Wave Radiation

Barber, Edward, Florida Agricultural and Mechanical Univ., USA; Buzyna, G., Florida Agricultural and Mechanical Univ., USA; Krothapalli, A., Florida Agricultural and Mechanical Univ., USA; NASA University Research Centers Technical Advances in Aeronautics, Space Sciences and Technology, Earth Systems Sciences, Global Hydrology, and Education; Feb. 22, 1998; Volumes 2 and 3, pp. 437-439; In English; See also 20000032189; No Copyright; Avail: CASI; A01, Hardcopy; A10, Microfiche; C01, CD-ROM

Since Lighthill introduced his general theories on sound generated aerodynamically (1952,1954), later to become the field of Aeroacoustics, people have been seeking ways to reduce jet noise. The latest driving force behind reducing jet noise is the interest in the development of a High Speed Civil Transport project (HSCT). This vehicle would be a supersonic successor to the present commercial airliner. In order to make the HSCT a viable project, the aircraft noise must be reduced to acceptable limits. There are many noise factors, such as the structural noise and engine combustion noise, but the noise produced by the turbulent jet, as studied by Lighthill (1954) and Ffowcs-Williams (1963) is our primary concern.

Derived from text

Aerodynamic Noise; Aircraft Noise; Aeroacoustics; Engine Noise; Noise Reduction

17

SOCIAL AND INFORMATION SCIENCES (GENERAL)

Includes general research topics related to sociology; educational programs and curricula.

20000032189 Alabama A & M Univ., Center for Hydrology, Soil Climatology and Remote Sensing, Normal, AL USA

NASA University Research Centers Technical Advances in Aeronautics, Space Sciences and Technology, Earth Systems Sciences, Global Hydrology, and Education, Volumes 2 and 3

Coleman, Tommy L., Editor, Alabama A & M Univ., USA; White, Bettie, Editor, NASA, USA; Goodman, Steven, Editor, NASA Marshall Space Flight Center, USA; Sakimoto, P., Editor, NASA, USA; Randolph, Lynwood, Editor, NASA, USA; Rickman, Doug, Editor, NASA Marshall Space Flight Center, USA; Feb. 22, 1998; 975p; In English, 22-25 Feb. 1998, Huntsville, AL, USA; See also 20000032190 through 20000032360; CD-ROM contains PDF files of the conference proceedings.

Contract(s)/Grant(s): NCC8-140

Report No.(s): NONP-NASA-CD-1999011585; ISBN 1-889335-06-1; No Copyright; Avail: CASI; A99, Hardcopy; A10, Microfiche; C01, CD-ROM

This volume chronicles the proceedings of the 1998 NASA University Research Centers Technical Conference (URC-TC '98), held on February 22-25, 1998, in Huntsville, Alabama. The University Research Centers (URCS) are multidisciplinary research units established by NASA at 11 Historically Black Colleges or Universities (HBCU's) and 3 Other Minority Universities (OMU's) to conduct research work in areas of interest to NASA. The URC Technical Conferences bring together the faculty members and students from the URC's with representatives from other universities, NASA, and the aerospace industry to discuss recent advances in their fields.

Author

Multidisciplinary Research; Education; Aerospace Engineering; Conferences; Earth Sciences; Hydrology; Aeronautics

20000031363 NASA Langley Research Center, Hampton, VA USA

Aerodynamic Characteristics, Database Development and Flight Simulation of the X-34 Vehicle

Pamadi, Bandu N., NASA Langley Research Center, USA; Brauckmann, Gregory J., NASA Langley Research Center, USA; Ruth, Michael J., Orbital Sciences Corp., USA; Fuhrmann, Henri D., Orbital Sciences Corp., USA; 2000; 18p; In English; 38th;

Aerospace Sciences, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-0900; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

An overview of the aerodynamic characteristics, development of the preflight aerodynamic database and flight simulation of the NASA/Orbital X-34 vehicle is presented in this paper. To develop the aerodynamic database, wind tunnel tests from subsonic to hypersonic Mach numbers including ground effect tests at low subsonic speeds were conducted in various facilities at the NASA Langley Research Center. Where wind tunnel test data was not available, engineering level analysis is used to fill the gaps in the database. Using this aerodynamic data, simulations have been performed for typical design reference missions of the X-34 vehicle.

Author

Aerodynamic Characteristics; Data Bases; Flight Simulation; Data Simulation; Wind Tunnel Tests

20000032611 NCI Information Systems, Inc., NASA Center for Aerospace Information, Hanover, MD USA

NASA Thesaurus Hierarchical Listing (Data File for Site Usage)

January 2000; In English; Data file in tagged text format; approximately 5.5 MB

Report No.(s): NONP-NASA-DF-2000043664; No Copyright; Avail: CASI; EA2, Multimedia; Data file. Terms and conditions apply; letter of agreement required.

The NASA Thesaurus Hierarchical Listing is an electronic data file containing all valid terms and hierarchies, nonpostable USE references, and related terms contained in the NASA Thesaurus. The scope of this controlled vocabulary includes not only aerospace engineering and the natural space sciences, but all supporting areas of engineering, physics, Earth sciences, and the biological sciences. The Hierarchical Listing is provided as an electronic file in tagged text format. Each element of the listing is marked with an identifying tag for easy manipulation. File size is approximately 5.5 MB.

CASI

Thesauri; Terminology; Hierarchies; Aerospace Sciences; Aeronautics; Astronautics

20000032612 NCI Information Systems, Inc., NASA Center for Aerospace Information, Hanover, MD USA

NASA Thesaurus Term List (Data File for Site Usage)

January 2000; In English; Text data file; approximately 308 KB.

Report No.(s): NONP-NASA-DF-2000043638; No Copyright; Avail: CASI; E09, Multimedia; Data file. Terms and conditions apply; letter of agreement required.

The NASA Thesaurus Term List is an electronic data file containing an alphabetical listing of over 17,900 authorized terms from the NASA Thesaurus (hierarchies, definitions, and cross references are not included.) The scope of this controlled vocabulary includes not only aerospace engineering and the natural space sciences, but all supporting areas of engineering, physics, Earth sciences, and the biological sciences. File size is approximately 308 KB.

CASI

Thesauri; Terminology; Aeronautics; Aerospace Sciences; Astronomy; Astronautics

20000032613 NCI Information Systems, Inc., NASA Center for Aerospace Information, Hanover, MD USA

NASA Thesaurus Supplement: A Three-Part Cumulative Update of the 1998 Edition of the NASA Thesaurus, Supplement 4

January 2000; 25p; In English

Report No.(s): NASA/SP-2000-7501/SUPPL4; NAS 1.21:7501/SUPPL4; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The NASA Thesaurus Supplement is a cumulative update to the 1998 edition of the NASA Thesaurus (NASA/SP-1998-7501). The Supplement, published every six months, includes all new terms and associated hierarchies added since the cutoff for the 1998 edition (December 1997). Parts 1 and 2 (Hierarchical Listing and Rotated Term Display) correspond to Volumes 1 and 2 of the 1998 printed edition. Definitions are included in Part 1; uppercase/lowercase forms are provided in both Parts 1 and 2. Part 3 is a list of deletions or changes to valid terms.

CASI

Thesauri; Hierarchies; Terminology; Aerospace Sciences; Aeronautics; Astronomy; Astronautics

19
GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs such as Apollo, Gemini, and Mercury spacecraft, Earth Resources Technology Satellite (ERTS), and Skylab; NASA appropriations hearings.

20000033257 Research and Technology Organization, Neuilly-sur-Seine, France

The AGARD History: 1952-1997

vanderBlik, Jan, Editor, Research and Technology Organization, France; Spring 1999; 215p; In English; Original contains color illustrations; ISBN 92-836-1079-2; Copyright Waived; Avail: CASI; A10, Hardcopy; A03, Microfiche

This book may be considered as a tribute to the works of Theodore Von Karman and Frank Wattendorf, his close associate and first Director of AGARD. Dr. Theodore von Karman (1881-1963), a well-known aeronautical scientist with friends in many countries, was intensely interested in international scientific cooperation. Soon after NATO was established in 1949, he conceived the idea of an Advisory Group for Aeronautical Research and Development (AGARD) under the umbrella of NATO, and he succeeded in starting it as a group of NATO early in 1952. It became the first scientific agency of NATO. As the first chairman of this NATO Agency, he developed a unique structure of technical-scientific Panels composed of scientists and engineers from the NATO countries who, on a voluntary basis, exchanged information, organized meetings, produced thousands of timely high quality publications, carried out joint projects, organized study groups for the NATO Military Committee and assisted each other in developing their research and development capabilities. Until his death in 1963, Von Karman, basically an aeronautical scientist but with much broader interests, tried to broaden the activities of AGARD. This did result, inter alia, in the formation of the Science Committee of NATO and the Defense Research Group, covering the broader areas of science and technology. AGARD itself grew to an organization with over 500 Panel members, and some 1300 people contributed annually to lectures, in working groups, in study teams, as consultants, etc. Indeed, it became a truly formidable technical-scientific supporting force backing the NATO community. In 1997, forty-five years after its formation, AGARD was amalgamated with the Defence Research Group of NATO (DRG), to form the Research and Technology Organization (RTO). This book records the deliberations of the AGARD National Delegates Board, and aspects of the work of the Aerospace Applications Studies Committee (mostly concerned with military strategic aeronautical matters) and of the Technical Panels, which constituted the main activity of AGARD.

Derived from text

North Atlantic Treaty Organization (NATO); Research and Development; Aeronautical Engineering; Histories

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